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Untangling the trends, consequences and risks of repeated pregnancy among adolescents in the Philippines

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Abstract

Background:

Despite national public health efforts to prevent childbearing in teenagers, the Philippines continues to show one of the highest adolescent fertility rates among developing countries. High fertility rates in adolescence mean that teenagers may also experience subsequent pregnancies during the teenage years, or repeated adolescent pregnancy. Occurrence of a repeated pregnancy during adolescence may involve a complex interplay of socio-cultural and systemic factors as well as risk factors exacerbated by the first pregnancy. Poor transition to parenthood during a repeated pregnancy may also compound the health burden and social disadvantage conferred upon adolescent mothers.

Current evidence about repeated adolescent pregnancy has primarily focused on high-income countries. Research from low- and middle-income countries (LMIC), such as the Philippines, has concentrated on adolescents' first pregnancies. Hence, there is a need for further research in the context of LMICs to identify outcomes and risk factors to be addressed in future public health interventions.

Aims:

This research has three major aims:

1. Investigate the prevalence of and trends in repeated adolescent pregnancies in the Philippines;
2. Assess adverse maternal outcomes and child stunting outcomes associated with repeated adolescent pregnancy in the Philippines; and
3. Explore individual, partner-related and socio-demographic risk factors associated with repeated adolescent pregnancy in the Philippines.

Methods:

I adopted a combination of approaches to investigate my research aims: analyses of cross-sectional and longitudinal surveys to generate new evidence, and meta-analysis of previously published evidence to inform my survey analyses.

To measure prevalence and trends of repeated adolescent pregnancy (RP), I used five waves of data from the Philippines National Demographic and Health Surveys (NDHS), a national representative cross-sectional survey routinely conducted in the

Philippines every five years since 1993. A sample of 1390 women aged 15-19 years who had experienced ≥1 pregnancy was selected and analysed using multivariate logistic regression.

To assess whether RP might lead to maternal complications and child stunting, I used the NDHS and the Cebu Longitudinal Health and Nutrition Survey (CLHNS) respectively. In NDHS, I examined the occurrence of maternal complications by comparing the first and second pregnancy outcomes of 860 adolescent mothers. In CLHNS, I analysed the prospective anthropometric data from 413 infants using generalised linear models and mediation analysis to assess the potential mediating roles of birthweight and feeding practices.

To identify relevant risk factors, I synthesised estimates from eligible articles using random-effects meta-analysis, then explored pooled estimates for sources of between-study heterogeneity using meta-regression and subgroup analysis. Findings from the meta-analytic review were consulted to build stepwise models using the NDHS.

I compared the effect estimates generated from the analyses discussed above with those of young adults (i.e. 20-24 year olds) using age interactions.

Key Findings:

Approximately 19% of non-nulliparous adolescents in the Philippines experienced a repeated pregnancy across all regions, socio-economic status and type of residence. While I observed a decrease over time in the prevalence of repeated pregnancies in young adults, the trends in younger girls (aged 15-18 years) remained consistent from 1993 to 2013. Filipino adolescents in their second pregnancy were at least three times more likely to report obstetric complications, irrespective of inter-pregnancy interval, when compared with their first pregnancy. RP also strongly predicted the occurrence and persistence of child stunting up to 24 months of age.

Influential factors were identified at individual, interpersonal and community levels. At the individual level, non-use of modern contraception and young age at first birth were strong risk factors for repeated adolescent pregnancy. Results from my meta-analysis also suggested higher RP risks among girls with depression, history of pregnancy loss and school discontinuation. At the interpersonal level, having an older partner and being in a de-facto relationship led to increased risk of repeated pregnancy. At the community level, consulting traditional healers for prenatal care and being of low socio-economic status were also more likely to result in subsequent pregnancies. I also found a consensus in the literature about the protective effect of community health worker visitations against RP in low-income settings.

Conclusions:

Over the past twenty years, one in every five adolescent mothers in the Philippines have experienced a repeated pregnancy. My study demonstrates that both adolescent mothers and their children face adverse health consequences, which may suggest disrupted physiological and psychosocial recovery from the first pregnancy.

My findings generate a unique framework to untangle the burden of RP in the Philippines. While studies in other LMICs are warranted to strengthen the evidence base for this important reproductive health problem, this study is important as it can serve as a robust model for future research in countries with comparable socio-cultural contexts.

Declaration by author

This thesis is composed of my original work, and contains no material previously published or written by another person except where due reference has been made in the text. I have clearly stated the contribution by others to jointly-authored works that I have included in my thesis.

I have clearly stated the contribution of others to my thesis as a whole, including statistical assistance, survey design, data analysis, significant technical procedures, professional editorial advice, financial support and any other original research work used or reported in my thesis. The content of my thesis is the result of work I have carried out since the commencement of my higher degree by research candidature and does not include a substantial part of work that has been submitted to qualify for the award of any other degree or diploma in any university or other tertiary institution. I have clearly stated which parts of my thesis, if any, have been submitted to qualify for another award.

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Publications included in this thesis

1. Maravilla, Joemer C., Betts, Kim, and Alati, Rosa (2018). Trends of Repeated Pregnancy and Birth among Adolescents in the Philippines from 1993-2013. Reproductive Health 15(1), 184. *Incorporated in Chapter 4*

Contributor	**Statement of contribution**
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Submitted manuscripts included in this thesis

1. Maravilla, Joemer C., Betts, Kim, Adair, Linda, and Alati, Rosa (2019). Offspring stunting from repeated pregnancy among young mothers in the Philippines. BMJ Sexual and Reproductive Health. *Incorporated in Chapter 5*

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<u>Other publications during candidature</u>

Peer-reviewed papers:

1. Meque, Ivete, Dachew, Berihun Assefa, **Maravilla, Joemer C.**, Salom, Caroline, and Alati, Rosa (2019). Externalizing and Internalizing symptoms in Childhood and Adolescence and the risk of Alcohol Use Disorders in Young Adulthood: A Meta-analysis of Longitudinal Studies. Australian and New Zealand Journal of Psychiatry

2. **Maravilla, Joemer C.**, Betts, Kim, and Alati, Rosa (2019). Increased risk of maternal complications from repeat pregnancy among adolescent women. International Journal of Obstetrics and Gynecology (Editor's Pick for April 2019). International Journal of Obstetrics and Gynecology

3. Ayano, Getinet, **Maravilla, Joemer C**. & Alati, Rosa. (2018). Risk of autistic spectrum disorder in offspring with parental mood disorders: a systematic review and meta-analysis. Journal of Affective Disorders.

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5. GBD 2017 Population and Fertility Collaborators (2018). Population and fertility by age and sex for 195 countries and territories, 1950–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet 392, 1995-2051.

6. GBD 2017 Mortality Collaborators (2018). Global, regional, and national age-sex-specific mortality and life expectancy, 1950–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet 392, 1684-735.

7. GBD 2017 Causes of Death Collaborators (2018). Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet 392, 1736-88.

8. GBD 2017 Disease and Injury Incidence and Prevalence Collaborators (2018). Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet 392, 1789–858.

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11. GBD 2017 Risk Factor Collaborators (2018). Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet 392, 1923-94.

12. **Maravilla, Joemer C.**, Betts, Kim, and Alati, Rosa (2018). Trends of Repeated Pregnancy and Birth among Adolescents in the Philippines from 1993-2013. Reproductive Health 15(1), 184.

13. Couto e Cruz, Camila, Salom, Caroline, **Maravilla, Joemer C**., and Alati, Rosa (2018). Mental and physical health correlates of discrimination against people who inject drugs: a systematic review. Journal of Studies on Alcohol and Drugs 79(3), 350-360.

14. Adewumi, Adeleke D., Hollingworth, Samantha A., **Maravilla, Joemer C**., Connor, Jason P. and Alati, Rosa (2018). Prescribed Dose of Opioids and Overdose: A Systematic Review and Meta-Analysis of Unintentional Prescription Opioid Overdose. CNS Drugs 32(2), 101-116.

15. Dachew, Berihun Assefa, Mamun, Abdullah, **Maravilla, Joemer C.** and Alati, Rosa (2018). Pre-eclampsia and the risk of autism-spectrum disorder in offspring: Meta-analysis. British Journal of Psychiatry 212(3), 142-147.

16. Dachew, Berihun Assefa, Mamun, Abdullah, **Maravilla, Joemer C.** and Alati, Rosa (2017). Association between hypertensive disorders of pregnancy and the development of offspring mental and behavioural problems: A systematic review and meta-analysis. Psychiatry research 260, 458-467.

17. Abajobir, Amanuel Alemu, Kisely, Steve, **Maravilla, Joemer C.**, Williams, Gail and Najman, Jake Moses (2017). Gender differences in the association between childhood sexual abuse and risky sexual behaviours: a systematic review and meta-analysis. Child Abuse and Neglect 63, 249-260.

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21. Abajobir, Amanuel Alemu, **Maravilla, Joemer C.**, Alati, Rosa and Najman, Jackob Moses (2016). A systematic review and meta-analysis of the association between unintended pregnancy and perinatal depression. Journal of Affective Disorders 192, 56-63.

Conference abstracts:

1. Symposium, 17th National Health Research for Action Forum, Philippines, October 2018: Maravilla, Joemer Calderon, Betts, Kim S., and Alati, Rosa. Do adolescents get pregnant again during teenage years? Untangling the burden of repeated adolescent pregnancies in the Philippines

2. Poster presentation, World Congress on Adolescent Health, India, October 2017: Maravilla, Joemer Calderon, Betts, Kim S., and Alati, Rosa. Why do adolescent girls get pregnant again? The risk of repeated adolescent pregnancy in the Philippines.

3. Poster presentation, World Congress on Adolescent Health, India, October 2017: Maravilla, Joemer Calderon, Betts, Kim S., and Alati, Rosa. Adverse maternal outcomes associated with repeated pregnancies during adolescence.

4. 3MT® presentation (Winner and People's Choice), 3MT® Heats Institute for Social Science Research, 2017: Maravilla, Joemer Calderon, Betts, Kim S., and Alati, Rosa. Kids having KidS.

5. 3MT® presentation (1st Runner Up), 3MT® Finals Faculty of Humanities and Social Science, 2017: Maravilla, Joemer Calderon, Betts, Kim S., and Alati, Rosa. Kids having KidS.

6. Oral presentation, World Congress on Public Health, Melbourne, April 2017: Maravilla, Joemer Calderon, Betts, Kim S., and Alati, Rosa. Trends of repeated pregnancy and birth among adolescents in the Philippines from 1993-2013.

7. Oral presentation, World Congress on Public Health, Melbourne, April 2017: Maravilla, Joemer Calderon, Betts, Kim S., and Alati, Rosa. Comprehensive meta-analytic review of factors influencing repeated adolescent pregnancy.

8. Oral presentation, 2015 School of Public Health RHD Conference, Brisbane, November 2016: Maravilla, Joemer Calderon, Betts, Kim S., and Alati, Rosa. Predictors and consequences of repeated adolescent pregnancy and birth in the Philippines.

9. Poster presentation, International Congress of Pediatrics, Vancouver, August 2016: Maravilla, Joemer Calderon, Betts, Kim S., Abajobir, Amanuel Alemu, Couto e Cruz, Camila and Alati, Rosa. The role of community health workers in preventing adolescent repeat pregnancies.

10. Oral presentation, Global Addiction Conference, Venice, October 2016: Couto e Cruz, Camila, Salom, Caroline, Maravilla, Joemer Calderon, and Alati, Rosa. Discrimination towards people who inject drugs (PWID): A systematic review about mental and physical health outcomes.

11. Oral presentation (People's Choice), 2015 School of Public Health RHD Conference, Brisbane, November 2015: Maravilla, Joemer Calderon, Betts, Kim S., and Alati, Rosa. Predictors and consequences of repeated adolescent pregnancy and birth in the Philippines.

Contributions by others to the thesis

The contribution of others to this thesis is detailed in the above section concerning co-author contribution to published journal articles.

Statement of parts of the thesis submitted to qualify for the award of another degree

No works submitted towards another degree have been included in this thesis.

Research Involving Human or Animal Subjects

This research is approved by the University of Queensland-School of Public Health Ethics Review Board on 11th of April 2016 with an approval number, JCM11042016.

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Adolescent pregnancy, teenage pregnancy, reproductive health, repeated pregnancy, maternal and child health, health worker, trends, meta-analysis

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FoR code: 1608, Sociology, 10%

Dedication

I dedicate this body of work to all teenage mothers in Mangkayan, Benguet, Philippines who deserve to have a second chance, better health and a better future.

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List of Abbreviations

ARH	Adolescent Reproductive Health
CCT	Conditional Cash Transfer
CDC	Centers for Disease Control and Prevention
CHW	Community Health Worker
CI	95% Confidence Intervals
CLHNS	Cebu Longitudinal Health and Nutrition Survey
DALY	Disability-Adjusted Life Years
DHS	Demographic and Health Survey
DOH	Department of Health - Philippines
FBD	Facility-based Deliveries
FP	Family Planning
LAZ	Length-for-age z score
IEC	Information and Education Campaign
IPI	Inter-pregnancy Interval
LCA	Latent Class Analysis
LMICs	Low- and middle-income countries
NDHS	Philippines National Demographic and Health Survey
OR	Odds Ratio
RB	Repeated (Adolescent) Birth
RH	Reproductive Health
RP	Repeated (Adolescent) Pregnancy
RRR	Relative Risk Ratio
SEM	Structural Equation Modelling

SES	Socio-economic Status
SIDS	Sudden Infant Death Syndrome
UNFPA	United Nations Population Fund
WHO	World Health Organisation
WtPrevRB	Weighted RB prevalence
WtPrevRP	Weighted RP prevalence

Chapter 1: INTRODUCTION

Teenage pregnancy epidemic in the Philippines

As nations around the globe evaluate their performance with regards to maternal health (Millennium Development Goal 5), the recently developed Sustainable Development Goal for better health and well-being (Goal 3) highlights the importance of universal access to sexual and reproductive health for adolescents [1, 2]. In spite of this consensus, several countries have yet to come close to achieving this ambitious goal - the Philippines is one such country.

Teenage pregnancy in the Philippines had been regarded as an ‘epidemic’ since 2011 [3, 4]. The World Health Organization (WHO) reported the Philippines as one of the three countries with the highest adolescent fertility rate in the Western Pacific Region [5]. The United Nations Population Fund (UNFPA) also recently stated that the Philippines is the only country in the Asia-Pacific with no significant reduction in adolescent fertility rates [6]. Over the past 20 years, the proportion of pregnant teenagers and mothers in the Philippines has doubled from 6.3% in 1994 to 13.6% in 2013 [7]. The UNFPA Philippines reported the same trend, with an almost 70% increase in the number of pregnant teenagers in the space of a decade [8]. A routine health survey in the Philippines also suggested a similar pattern of adolescent fertility rates from 46 births per 1000 women in 1970 to 57 births in 2013 among women aged 15-19 years [9]. In order to address these issues, preventive policies and programs [10, 11], together with epidemiological and exploratory studies have been developed to provide evidence of the current sexual health and behaviour of Filipino teenagers [12, 13].

Exploring the problem of repeated pregnancy among adolescents

The Philippines' health system has put little emphasis on the more serious problem of adolescents' repeated pregnancies and births. Globally, adolescent mothers have a 50% chance of a repeated pregnancy within two years postpartum [14]. In Western Australia, a 33% rate of rapid repeated pregnancy within 24 months postpartum has been noted [15]. The Centres for Disease Prevention and Control has observed that 1 in every 5 American teen mothers experienced subsequent births [16]. The European region has also reported that approximately 65 per 1000 teenagers had either a repeated abortion or an abortion preceded by previous livebirth [17, 18]. In the Philippines, my preliminary analysis using the Philippines Vital statistics data showed 16% prevalence of repeated adolescent births [19-21]. Similar to estimates from the US, this estimate from the Philippines Vital statistics data remains an underestimate as this excludes those who experienced pregnancy loss.

Why should we be particularly concerned with repeated pregnancy? Repeated pregnancies may add further physical, mental and social burden not only to adolescent mothers but also to their children [22, 23]. Physiological immaturity and nutritional insufficiency have been found to lead to maternal and neonatal complications including death [17, 24-26], and children from repeated pregnancies display increased developmental disorders and debilitating conditions [27, 28]. For adolescents, emotional unpreparedness can result in impaired social skills and behavioural problems [17, 25, 26]. Effects of repeated pregnancy may continue into the next generation with the children of teen mothers more likely to become teen mothers themselves [24, 29]. Adolescents with at least two children usually drop out of school and experience reduced employment opportunities [17, 30]. These individual and social disadvantages can in turn lead to outcomes such as illicit drug use, isolation, low self-esteem and disinterest in life goals [25, 31].

Although an adolescent’s first pregnancy is known to result from an interplay of various internal and external factors, the occurrence of repeated pregnancy may further complicate this paradigm at individual, interpersonal and community levels. Socio-economic status (SES) appears to be important, as those in the lowest SES quintiles are at greater risk of repeated pregnancy compared with wealthier adolescents [17, 32]. Motivation, knowledge and access to contraceptive services are also suggested as influencing repeated adolescent pregnancy [14, 33]. Relationships, both with family members and partners also influence the reproductive health outcomes of first-time mothers. For example, poor mother-daughter relationships as well as being married [17, 31] and living with partner have been found to encourage intention towards having another child [25, 29]. All these factors may directly or indirectly alter adolescents’ attitudes towards family planning use.

Although existing literature has explored the contexts behind repeated pregnancy in poor communities in western industrial nations, data in low- and middle-income countries (LMICs), such as the Philippines, remain inadequate and scarce. Adolescent mothers, as they attend the healthcare system through prenatal visits and delivery in health facilities, represent a ‘ready-to-catch population’ in the prevention of repeated pregnancy. Yet, absence of local and national data hinders the development of proper health measures to address this problem in the Philippines.

This project aims to provide the evidence needed to establish a significant paradigm shift in the formulation of appropriate health interventions for high risk Filipino adolescents. With the Philippines' increasing pattern of early sexual initiation [7], mapping out factors and disparities on this specific issue can help in developing effective holistic strategies to promote reproductive health for this vulnerable group. I focus on identifying relevant factors and adverse outcomes as reference points for future RP-related interventions, and exclude systems and policy analysis due to recent and extensive reviews completed in the Philippines [34, 35].

Significance of the study

Knowing the magnitude and impact of repeated adolescent pregnancy is vital in conceptualising more robust research on adolescents' childbearing outcomes and in designing preventative actions to address this alarming health problem. Findings from this study feed into the future development of secondary pregnancy prevention interventions especially in settings, such as the Philippines, with a restrictive socio-political situation and inadequate programs to address RP risks among first-time mothers. This will also provide evidence-based information to formulate strategies to improve access to contraceptive and reproductive health services.

Repeated adolescent pregnancy is an important indicator not only of the health of adolescents and their children but also of health systems service utilisation and equity [36-38]. For example, high rates of repeated adolescent pregnancy may indicate inadequacy of local family planning services to cater for this vulnerable group. Therefore, the WHO and other international stakeholders may use novel evidence found from this study to develop specific guidelines and global targets towards secondary pregnancy prevention and management.

Finally, repeated pregnancy is an emerging issue not only among adolescents in the Philippines but also in other LMICs. Though this project focuses on one country, its findings are likely to be applicable to other LMICs, particularly in the Asia-Pacific region. Exploring this social and public health problem in the Philippines can be the first step towards a cross-country analysis among low and middle-income countries. Moreover, being the first mainstream study to look into repeated pregnancy in the Philippines, this may serve as an "eye-opener" and motivate the establishment of more sophisticated studies, especially those with longitudinal designs able to follow up adolescents into their early reproductive years.

Aims of the current work

This project will contribute to the establishment of evidence which will enable an in-depth understanding of repeated pregnancy among adolescents. This project has the following major research aims:

1. Investigate the prevalence and trends of repeated adolescent pregnancy and births in the Philippines.
2. Assess maternal outcomes and child stunting associated with repeated adolescent pregnancy.
3. Explore individual, partner-related and socio-demographic factors of repeated adolescent pregnancy.

Thesis structure

Chapter 1 discusses the extent of repeated adolescent pregnancy as a public health problem, the need for local investigation and how this project will contribute towards improvement of adolescent reproductive health in the Philippines. **Chapter 2** is divided into four sections and outlines the existing literature and existing theoretical frameworks around repeated adolescent pregnancy. The first section discusses the extent of the problem in countries from which the issue has been extensively investigated. The second and third sections discuss factors and outcomes for teenage mothers and their children. The fourth describes existing secondary prevention programs and evaluations as well as national strategies in the Philippines. **Chapter 3** outlines the methodology; the meta-analytical procedures used to pool estimates from the literature and the statistical analyses conducted. It also describes the datasets used to answer the research questions posited in this thesis. These data sets include the Philippine Demographic Health Surveys and the Cebu (Philippines) Longitudinal Health and Nutrition Survey.

Chapters four to seven discuss the results. **Chapter 4** investigates trends of repeated adolescent pregnancy and birth in the Philippines. **Chapter 5** describes how repeated pregnancy affects adverse maternal health outcomes and infant growth. **Chapter 6** comprehensively explores socio-demographic, family planning and reproductive health factors using meta-analysis and repeated cross-sectional analysis. In **Chapter 7,** the effectiveness of community health workers as a potential secondary prevention program in the Philippines is presented in the form of a systematic review.

Chapter 8 presents a summary of findings, potential mechanisms behind the findings, general limitations of the study and implications for future action.

Chapter 2: LITERATURE REVIEW

Early pregnancy among adolescents

Adolescent pregnancy is a social and public health problem in most countries around the globe. Every year, 49 in every 1000 girls worldwide give birth to their first infant during the teenage period [39]. The World Health Organization (WHO) found that two of every ten births is attributed to adolescent girls aged 10-19 years old [40, 41]; this figure constitutes 16 million girls aged 15-19 years and 2.5 million girls under age 16 from low- and middle-income countries (LMICs) [39, 42]. Teenage births in LMICs represent at least 95% of the total births globally [40], and adolescent birth rates in these countries are two to five times higher than in high-income countries [41].

Globally, the risk of death due to maternal-related causes tends to be higher among adolescents than older women [5]. Complications during adolescent pregnancy are considered the leading cause of death and disability among those aged 15-19 [42, 43]. The overall burden of disease attributable to pregnancy and childbirth is 23% [40, 41], and 15% of this has been attributed to teenage pregnancies [44]. A systematic analysis of the global burden of disease for young people aged 10-24 has found maternal sepsis to be the 6th leading cause of disability-adjusted life years (DALY) among those aged 15-19 (3.1%) and 20-24 (3.7%) years [45]. In these two age groups, maternal conditions were the 4th leading cause of disability and 3rd leading cause of DALY worldwide [43] and within each region [45, 46]. Therefore, early childbearing can cause greater adverse physical outcomes in adolescents. These include pregnancy and postpartum complications and maternal death, which may occur especially if there is lack of access to antenatal and intrapartum services [40, 47].

Early pregnancy also leads to socioeconomic disadvantage and risky behaviours which may impact adolescents' transitions into adulthood [47]. Teenage women from low socio-economic status who experience an early pregnancy tend not to complete secondary school education [47-49], which in turn prevents adolescents from obtaining financial independence, and this may lead to a continuous cycle of poverty [50, 51]. Adolescent motherhood has also been found to be associated with greater risk of depression, suicidal ideation, and the use of illicit drugs and other substances [52]. Studies have also shown that parenting and pregnant adolescents are at risk of domestic violence either as victims or perpetrators [53].

While steps have been taken to address this issue in high-income countries [54], adolescent pregnancy remains a public health concern in LMICs. The latest Global Burden of Disease study reported maternal disorders as the 11th leading cause of death among 10-19 year old adolescents in LMICs [46]. One of the countries with some of the most concerning statistics is the Philippines. The WHO reported that the adolescent fertility rate of 53 births per 1000 in the Philippines was one of the three highest in the West Pacific Region, next to Laos and Cambodia [5, 39]. The Philippines is one of six countries with the highest teen pregnancy rate in the ASEAN region [55] and the only country in the Asia-Pacific with no significant decrease in its adolescent fertility rate in the last 20 years [6, 9]. Indeed, some reports suggest a doubling of births and pregnancies among teenagers from 6.3% in 1994 to 13.6% in 2013 [7]. Teenage pregnancy continues to cause maternal-related morbidity and mortality in this country, clearly reflected in this country's mortality figures [56]. The Philippine Statistics Authority reported that maternal deaths among Filipino teenagers rose from 96/100,000 livebirths in 2000 to 164/100,000 livebirths in 2010

[57]. This suggests the severity of the problem as well as the poor reproductive health conditions faced by Filipino adolescents.

While the Philippines is still in its initial efforts to address the problem of adolescent pregnancies, an even more concerning issue is the case of teenagers who conceive again soon after their first pregnancy. This is referred to as **repeated adolescent pregnancy (RP)**. This chapter, therefore, explores this issue by first examining the existing evidence on RP, and then contextualising the need for a new investigation in a LMIC such as the Philippines.

Burden of repeated adolescent pregnancy

Definition

Repeated adolescent pregnancy (RP)[1] is defined as a subsequent pregnancy among adolescents aged 10-19 years ending in abortion, miscarriage, stillbirth or livebirth [36, 58]. On the other hand, repeated adolescent births (RB) is defined as a subsequent pregnancy ending in a livebirth among adolescents 10-19 years old [16, 59]. Unlike RP which can be preceded by abortion, miscarriage, stillbirth or livebirth, RB can only be preceded by a livebirth [41, 60]. The definition of RP has been further expanded to include time intervals between pregnancies/births. Several studies have used 24 months after the first pregnancy as the ceiling for a closely-spaced RP or RB [15, 41, 58, 61].

In general, RP is considered an important indicator of reproductive health and other health-related characteristics. Disparities in this indicator, especially among minority groups and disadvantaged populations, imply poorly-distributed and unequal access

[1] Calculating the rate involves dividing the number of RP by the number of pregnancies (livebirths in case of RB) among adolescent girls in the same age range, then multiplying it by 1000. Number of adolescents can also be used as the unit of analysis to measure subsequent conception instead of birth or pregnancy.

to reproductive services [36]. It is also correlated with low educational attainment, limited employment opportunities and, ultimately, poverty [36, 62]. From a health economics perspective, RP has been estimated to have led to an increase in childbearing costs up to USD 9.4 billion as a consequence of the long-term dependency of teenagers and their families on welfare assistance [36-38]. In 2008, the United States spent USD 11 billion and USD 2.8 billion annually to support the childbearing of adolescent girls and welfare benefits of children born of adolescent mothers respectively [30].

Hence, RP reflects both the reproductive health status of adolescents and the service capacity of local communities. Although numerous social and health issues have been linked to RP, several low and middle-income countries have not been able to measure the extent of the problem [63].

Extent and magnitude

Published data on RP mostly derives from research undertaken in North America, Latin America, Europe and Australia. The Centre for Disease Prevention and Control has suggested that 20% of American teenage mothers have experienced more than one live birth [16, 59]. Canada had a lower average annual rate of 2.6 subsequent births per 1000 adolescent aged 15-19, ranging from 1.6 in British Colombia to 31.9 in Nunavut [27]. Chile's 60% repeated pregnancy rate is the highest among Latin American countries [25], followed by Puerto Rico [64] and Brazil [65]. In Australia, one in every three teen mothers experienced repeated pregnancy within 24 months following their first delivery [15]. Finally, a report from Europe indicated a maximum RP rate of 64.7 per 1000 teenagers [17].

Elevated proportions of adolescent girls with RP in these settings suggest RP's impact on adolescents' health and development. A US-based study by Sadler and

Catrone [66] proposed that adolescent mothers usually experience a stressful physiological and psychosocial shift known as the “dual developmental crisis”. Their study conceptualized dual developmental crisis using behavioural themes and patterns from a series of clinical observations to come-up with a parallel developmental continua which compares the developmental milestones in adolescence and parenthood. Dual developmental crisis primarily suggests how the adjustments undergone by adolescent girls through pregnancy add to the physiological, emotional and cognitive changes brought about by puberty. These multiple transitions may cause conflict, particularly in relation to role reassignment and value orientation. For example, after birth, it is expected that the adolescents’ interest towards self (e.g. body changes due to pregnancy, personal needs) is redirected towards her infant. Adolescents may struggle to accept the shift to motherhood, which often also involves competing demands from her new infant, partner and other members of the family.

Therefore, it is likely that the occurrence of another pregnancy in the teenage years increases the possibility that young mothers will fail to an even greater extent than teenage mothers with a single child to adjust to these parallel processes [31, 66, 67].

Adolescents’ cognition may still be immature to cope with the problem-solving demands of parenthood. With the occurrence of an RP, adolescents simultaneously face the challenges of being a parent, the pressure of a quicker transition to adulthood and the additional demands brought about by a subsequent pregnancy. This tension may explain poor caregiving, including suboptimal feeding practice, non-compliance to medical advice and improper infant handling, commonly observed in adolescent mothers [67].. Also, the aggravated emotional conflicts during an RP may predispose adolescent girls to poorer health seeking behaviour [68], which influences a chain of maternal as well as offspring future health outcomes . These are discussed in detail below.

Maternal outcomes

There is a dearth of literature on maternal outcomes following a repeated pregnancy in adolescence. Repeated pregnancy during this life period may deteriorate physical and psychological well-being and increase physical, mental and socio-economic difficulties experienced during and after the first pregnancy [16, 29, 69]. The risk of pregnancy-induced hypertension, severe anaemia [70] and death [71] due to pregnancy-related causes were found to be higher after a second adolescent pregnancy [27]. This was not confirmed in a recent Turkish study where no associations were seen between gestational complications (i.e. diabetes mellitus, pre-eclampsia and preterm labour) and (second) birth order [72]. Studies on maternal outcomes are too scarce to come up with conclusive results and to comprehensively analyse the heterogeneity among studies. Therefore, more studies are needed to establish and clarify maternal outcomes and their relationship with RP.

Recent studies concerning the elevated risks of obstetric complications during an RP also have methodological limitations in eliminating bias due to residual confounding and clustering effects. Instead of comparing first and succeeding pregnancies of the same adolescents, studies often compared adolescents who had one pregnancy to those with repeat pregnancies. Such approach fails to account for biological maturity [73]. Studies which used the same mothers have failed to adjust for clustering effects which can lead to biased estimates due to changes in social and obstetric factors across pregnancy order [74].

Child outcomes

Adolescent RP increases the risk of poor child health outcomes which include neonatal, post-neonatal and infant mortality, as well as low birthweight [17, 22, 75]. Preterm delivery and foetal growth retardation have been observed among second and higher birth orders of adolescents [22, 76]. Perinatal deaths may also occur because of nutritional insufficiency [77, 78] and ectopic pregnancy [79].

Birth outcomes

Some epidemiological studies have observed associations of RP with the occurrence of preterm delivery. A cross-sectional study by Akinbami and colleagues [76] investigated the risk of preterm births among multiparous teens in the USA and concluded that a longer inter-pregnancy interval lowered the risk of premature delivery. Another population-based study in the USA found the incidence of preterm birth was higher for the second birth, with an increased risk of 2.36 times [74]. This study was able to compare adverse outcomes with the first childbirth experience of the same adolescents to control for the effect of biological and other medical conditions. Partington and colleagues [74] found that short inter-pregnancy interval (less than 3 months) led to a three-fold higher risk of low birthweight in fully adjusted analysis [74]. The retrospective cohort study by Santelli and Jacobson [80] also suggested low birth weight (less than 1500 g) was higher among mothers who had their first and second pregnancy between 15-19 years of age than those who had their two pregnancies separately during teenage and young adulthood periods. Another US-based cohort study, however, found opposite results; that is, the authors found an increase in mean birthweight among infants from a repeated pregnancy [22]. However, this study was biased towards selecting adolescents with high socio-economic status which led to these results [22].

Developmental Outcomes

Evidence also indicates that offspring of RP have increased risk of developmental problems, behavioural issues [81] and low academic/school performance measures [41]. Children may also be at risk of abuse and neglect [82] due to punitive and/or inadequate parenting styles [83]. Others also suggest poorer school performance, [75], violent and anti-social behaviour [41, 84] and higher symptoms of depression [51] in exposed offspring, when these are compared with offspring of mothers with no repeated pregnancy [75, 85]. An analysis of cohorts from five LMICs, including the Philippines, found a decline in height-for-age *z* score among <20 year old mothers with at least two livebirths after univariate correlation test [86], which suggests occurrence of offspring stunting among teen mothers with high parity scores. Despite the strong research design of these cohorts, analysis in this multi-country study failed to account for confounders such as feeding practice and low birthweight. In general, although there are strong arguments about the impact of RP on child health and development, studies are too scarce to provide an overall consensus on the subject.

Factors associated with repeated adolescent pregnancy

Identifying factors of RP which are amenable to intervention is necessary to develop preventative strategies and to avert poor health outcomes resulting from RP. Yet, there is only one systematic review, conducted by Rigsby and colleagues [83], that has reported the range of factors which may be associated with RP. This review included 20 studies comprised of a mixture of descriptive, cross-sectional and case-control studies published between 1966 and 1997. A MEDLINE search identified 31 factors ranging from socio-demographic, familial, psychosocial, educational, obstetric, and family planning characteristics. This review found race as the most commonly identified factor associated with RP; however, non-significant results were found due to racial homogeneity leading to low power to detect differences. Low socio-economic status was also associated with increased odds of RP. The protective effect of higher educational level also suggested a strong SES influence. Religious affiliation with the Catholic religion was a risk factor compared to being a Protestant, possibly reflecting the Catholic Church's strong views against contraception. The use of long-acting contraceptives, provided soon after the first pregnancy, was found to be protective against RP up to three years postpartum.

Two recent reviews further discussed RP [17, 70]; however, one review looked at RP in the broad context of sexually transmitted disease and sexual risk, condom use and contraception, while the other one was a narrative account of RP factors. Meade and Ickovics [70] reviewed 22 studies on RP and found that relevant factors influencing RP were use of implants, previous miscarriage, child bearing attitude, intention of first pregnancy, perceived parental support and befriending pregnant peers. The narrative review by Rowlands [17] in 2010 used ecologic theory to group predictors into individual factors, couple and family-related factors, peer, community level and social system predictors. Rigsby and colleagues [83] is therefore the only rigorous and systematic investigation of the existing evidence on factors influencing RP. Nearly 20 years later, a more comprehensive and updated review of studies is needed, using a wider range of search engines to identify new evidence [63].

More recent evidence indicates a multifaceted inter-play of factors associated with RP [63]. These studies primarily used two theoretical frameworks (i.e. problem-behaviour theory, and socio-ecological theory) to outline the complexity of such factors. *Problem-behaviour theory* purports a framework through investigation of teenagers' risky sexual behaviours [87]. This theory focuses on the interaction of personality, perceived environment and behavioural systems. The *personality system* refers to the educational and social experiences of adolescents before and after their first pregnancy that can be deemed as either protective or risk factors. Potential protective factors include educational aspirations, self-esteem, locus of control and religiosity while risk factors comprise mental health problems such as depression, aggression and anxiety [61, 87]. The perceived *environment system* includes social dimensions which influence behavioural expressions towards family and peers. Parental norms can affect adolescents through disciplinary measures and/or family values. Peers become more influential as teens become more independent and develop a sense of belonging to a social environment. The *behavioural system* consists of the inter-play among socially learned behaviours, function, significance and meaning and may include substance abuse, and delinquent and sexual behaviour.

Unlike problem-behaviour theory, *socio-ecological theory* has been well regarded by most studies on adolescent reproductive health in developed countries. This theory proposes a framework of microsystem, mesosystem and exosystem as the basis to analyse RP dynamics [78]. Microsystems (individual factors) reflect adolescents' individual characteristics and attitudes that affect their everyday experience through their social interactions. Mesosystems (interpersonal factors) represent relationships of microsystems with the dynamics in family, school and local community, which shape adolescents' values and perceptions towards having another pregnancy. Finally, the exosystems (community factors) characterises macro-level dimensions which may exert direct or indirect effects such as socio-economic status, policies and laws, which enable or inhibit adolescents to access reproductive health services.

Several new studies have also adapted this framework to better understand underlying factors of RP. Adolescent birth cohorts in the US identified pathways to second pregnancies by analysing different individual, familial, partner-related, and community factors [17, 33, 88]. Another cohort study considered the proximity of each predictor and merged the socio-ecologic domains into proximal and distal predictors [89]. Distal factors were partner support, externalising behaviour, socio-economic status and type of peers, while contraceptive use and family planning attitudes were classed as proximal. Although this study proposes slightly different structural frameworks, their findings suggest that the causal pathway of RP is likely to be an interaction of factors at different social levels and individual domains [90].

The socio-ecologic framework strongly relates to the Philippines' unique socio-cultural characteristics, affecting adolescents' RP risks at individual, interpersonal and community levels. At the individual level, the commonly observed low self-esteem and interrupted school attendance further aggravates the disrupted psychosocial transition of first-time Filipino adolescent mothers [91]. At the interpersonal level, early cohabitation and control issues between adolescents and their male partners have negatively influenced adolescents' attitude towards delaying another pregnancy due to the cultural stigma against family planning [34]. At the community level, socio-economic status impacts access to contraceptive services and trained service providers, while religion affects the community norms on family planning and the implementation of reproductive health programs [92].

The following section groups risk factors for RP into *individual, interpersonal and community factors* (in accordance with the socio-ecological framework). The results of a more comprehensive and meta-analytical review are discussed in **Chapter 6**.

Individual level factors

Apart from the influence of family planning, individual level factors also include obstetric history, age, and mental health and behaviour.

Family planning attitudes

Recent evidence reveals a well-defined consensus about the impact of family planning attitudes towards reduction of risk for RP. Except from in one study [93], the use of modern contraceptives has been found to reduce RP risk [58, 89, 94-96], especially if contraception is taken up in the immediate postpartum period (less than 6 weeks) as most adolescents resume sexual activity beyond this period [33, 97]. Among the different contraceptive methods available, studies suggest the use of implants is more effective in reducing pregnancy recurrence compared to other long-acting reversible methods, such as IUD and Depo-Provera [33, 58, 97-99].

Studies from the USA [33] and Australia [15] have found intention to become pregnant as a strong predictor, which suggests that a contraception plan can help delay a new pregnancy [47, 94]. This is supported by another study which suggested the importance of having a prenatal contraception plan to prevent pregnancy recurrence within two years after the first pregnancy [94].

Obstetric history

Obstetric history has been investigated as a potential factor. Five studies have explored the effect of a previous abortion or miscarriage on RP. Three birth cohorts have found a four-fold increase in RP risk among adolescents who had pregnancy loss [96, 100, 101]. Apart from abortion, having an intended first pregnancy also has a positive effect for RP [102], the experience of an unplanned pregnancy has been shown to negatively influence positive attitudes on family planning [103].

Clinic visits during the antenatal or postpartum period also show a decrease in RP risk. Two hospital-based studies reported that having prenatal examinations and post-natal visitations reduced the odds of RP by 87% [93] and 68% [58] respectively.

Maternal age

Adjusted analyses from four different studies found that older maternal age increases the odds of RP by at least 66% [78, 93, 96, 104]. On the other hand, five epidemiological studies showed null results [61, 95, 100, 103, 105]. Some studies reporting the relationship of adolescents' age during first conception with the risk of another pregnancy [60, 89, 102, 106, 107] found older age increased the risk of RP up to threefold. However, three other studies contradicted these results, finding instead a 22% reduced risk [60, 87, 100].

The above evidence suggests discrepancies with the relationship between RP and maternal age. These may be due to methodological issues, such as sample homogeneity; however, the effect of age across follow-up periods needs more careful investigation to ascertain whether there is a true association between age-related factors and RP risk. These inconsistencies are also influenced by whether age is considered as categorical or continuous [63]. It can be argued that categorising age would produce more meaningful results rather than using estimates based on the increase in age by one year.

Mental health and behaviour

Mental health problems have been associated with increased risk of repeated pregnancy [95, 100]. Barnet and colleagues [95] suggested that depression may lead teens towards inconsistent use of contraceptives and/or to look for another partner due to a poor sense of belonging either within the family or with the father of her first child. Despite evidence of an association between depression and repeated pregnancy, it is essential to investigate the relationship between mental health status and sexual behaviour and to account for changes in mental health during pre-pregnancy, after first pregnancy, and after second (or repeated pregnancy) [78].

The impact of self-esteem on RP is unclear as the odds ratios for an association with RP range from 0.36 to 4.60 across four different studies [60, 78, 87, 103]. As to the impact of problematic behaviour on risky sexual behaviour, studies on violent behaviour and substance use have consistently found no associations with RP [60, 61, 78, 87, 89, 95, 100].

It is thus not fully established whether sexual behaviour increases vulnerability to RP. The number of sexual partners and early sexual initiation did not increase RP risk in some studies [60, 78], whereas frequent intercourse led to higher odds of rapid RP among adolescents [15, 78, 89]. However, these studies did not account for non-use and incorrect use of contraceptives. Thorough investigation is therefore needed to determine whether null association of sexual behaviour can be attributed to the indirect effect of sexual behaviour on RP through other proximal factors such as contraceptive use and intention for future pregnancy.

Interpersonal level factors

Interpersonal factors may involve partner's age, romantic relationship, as well as family and peer relationships.

Partner's age

Studies that have looked at the age difference between adolescent girls and their partners found no effect on RP [95, 100, 102], with the exception of Raneri and Wiemann [33], who found that having partners who are older by at least three years led to a 60% increased risk of another pregnancy. This result was supported by an earlier study and argued the intention of older partners to have the first and succeeding pregnancies [108].

Unlike the previous three studies [95, 100, 102], the research by Raneri and Wiemann [33] had a prospective design which enabled a robust analysis. Moreover, this study rigorously tested partner's age by conducting multivariate tests compared to others that only employed bivariate analysis.

Romantic relationship

Recent evidence showed uncertainties about the association of adolescent-partner relationship with RP. Being in a romantic relationship increases the risk of having another child by 3.4 times according to one study [60], whereas living with a partner can double the risk for frequent sexual activity and another pregnancy [60, 93]. A US-based study has found that support from the adolescent's partner, especially in childcare, increased RP risk [107]. In contrast, one study [33] reported that being in a romantic relationship with the father of the first child decreased the risk of another pregnancy, and another [102] found reduced risk for unintended RP among married adolescents. Further, there are also studies which observed no links between RP and de facto relationships [95, 100] or being married [60, 94, 105, 107].

Family and Peers

Familial involvement, such as living arrangements with parents or relatives and mother's support, shows conflicting relationships with RP, ranging from weak associations [60, 61, 96, 107], protective effects, [60, 102], but also greater risk of RP for perceived high parental monitoring [107, 109]. The influence of peers who share a similar experience of teen motherhood has also been linked to increased risk of RP [33, 89, 110].

Community level factors

Community level factors consist of educational status, income class, and race and religion.

Socio-economic status

Studies about the effects of maternal education on RP risk reported consistent findings. Participation in education was found to be a protective factor in one study [83], continuation of school attendance showed an inverse relationship with RP in four studies [14, 33, 93, 95], and high levels of education were linked to a decrease in RP risk [93, 100, 107].

Being employed is usually considered a protective factor for health and wellbeing. However, only one study [107] showed that having a paid job reduced the chance of a RP, unlike the other cohort studies with no positive associations [61, 78, 93].

Longitudinal analyses on income found income class to have a null effect on RP [61, 87, 107]. Despite this consensus on income class, confirmatory analyses are warranted by using income class as a composite variable that considers not only adolescents' monthly income but also type of housing and ownership of selected assets (e.g. television, radio and vehicles), due to its proven relevance and reliability to measure SES [111].

In general, findings from existing evidence suggest that school attendance and educational attainment are significant RP markers compared to other SES related factors.

Race and Religion

In the United States, Hispanic and Black Americans have been found to have 73% and 86% greater risk of repeated pregnancy respectively compared to Caucasian Americans [100, 105]. A cohort study in Western Australia also found that being an

Indigenous Australian is associated with a 2.38 fold increased risk of pregnancy within 24 months postpartum [15]. However, other studies have suggested no racial disparities in RP risk since most respondents were from minority groups in these studies [61, 87, 94, 102, 104, 107].

Religion affiliation might affect teenagers' attitudes towards and understanding of sexual behaviour and family planning practices. Findings are, however, mixed. Whereas one study concluded that being a Roman Catholic reduces risk for RP [102], another study found the opposite; that is, frequent attendance in religious activities increased the risk of another pregnancy [87].

Multiple factors

Two studies have been able to look into the effect of cumulative risk factors on RP. Stevens-Simon and colleagues [98] analysed the influence of what they defined as static and modifiable risk factors. They found the presence of at least nine of these factors increased the risk of RP by 2.37. Sims and Luster [103], on the other hand, measured a number of protective factors (i.e. self-esteem, problem-solving ability, likelihood of completing high school, maternal support, interest in joining a prevention program), grouped as personal resources, and found these decreased the risk by at least 60%.

Synthesis

Recent literature consistently showed depression, a history of abortion, and school discontinuation as strong predictors of RP. Evidence revealed that use of contraception and having a prenatal contraception plan, as well as high educational attainment, significantly protect adolescents from another pregnancy. However, there are still insufficient studies to support the association of RP with prenatal visits, partner support and peer characteristics. Inconsistent findings were also observed among maternal age, partner's age, income class, race and religion.

The systematic review undertaken for this thesis also revealed that RP definition (i.e. whether repeated pregnancy or repeated birth) did not cause disparities in effect estimates across studies [63]. Hence, the effect of these factors resulted in similar effects on repeated pregnancies and repeated births. This consensus in the literature led this project to primarily use repeated pregnancy during analyses due to its appropriateness in the Philippines setting.

Among the recent studies discussed, only three studies have employed rigorous modelling techniques [33, 89, 107]. These studies first simultaneously analysed factors per domain before coming up with a final (or full) model, which reduces unnecessary exclusion of highly relevant factors due to over-conservativeness of multivariate tests. This is also useful when dealing with large datasets, such as the datasets used in this project, particularly with exposure variables that may only be statistically significant due to large sample size.

While the evidence above presents more updated information and higher quality studies about RP factors compared to the 1997 review mentioned earlier, most of these are conducted in developed countries limiting its generalisability only to these settings [17, 112]. No formal investigation has been conducted to assess the magnitude of repeated pregnancies and births among adolescents in LMICs such as the Philippines, where teenagers are at high risk due to the provocative influence of cultural and social norms on early sexual activity [7, 9] and low use of modern contraception [6, 12].

Related research in the Philippines

Some studies have attempted to explore adolescents' risk of repeated pregnancy in the Philippines, however, I found contextual and methodological issues in these studies. A WHO multi-country research project [113] discussed the relationship between age and parity among Filipino adolescents, and a recent national survey on adolescent fertility in the Philippines suggested the association of non-use of contraception [114] and reduced access to prenatal care [115] with increase in parity. However, multi parity in these studies was not investigated on its own as the outcome variable. Estimates on multi parity were also biased as these were not adjusted for other important predictors and confounders.

A recent analysis from a thirty-year cohort of Filipino mothers in a metropolitan area investigated predictors of fertility - defined as the number of living children of young women aged 25 years. Findings from this cohort suggested the benefits associated with higher levels of mother-daughter communication [116] and the risks associated with multiple partners and cohabitation [117]. However, these findings do not demonstrate RP risks in adolescents since fertility in this study was measured during young adulthood (i.e. 25 years of age). Factors in this age group may differ as Filipino women in their mid-twenties are usually in transition from wanting to prevent pregnancy to intending pregnancy [116, 118].

Despite the lack of epidemiologic studies on repeated pregnancy in the Philippines, studies of adolescent sexuality and reproductive health provide insights on psychosocial characteristics, gender issues and other postnatal experiences of adolescents who experienced repeated pregnancy.

A phenomenological study explored the lived experiences of 10 adolescent mothers through in-depth interviews triangulated with parents and peers [119]. Results from this qualitative analysis revealed characteristics which can distinctly predispose adolescent mothers towards a subsequent pregnancy. Poor school performance and school discontinuation were verbalised as common outcomes during and after pregnancy. Some also identified parenting as their future role and considered it more important than their education/career goals. Others tended to have lower incomes as they faced discrimination when seeking employment. Due to financial instability, adolescent mothers also reported feeling depressed [91].

Negative cultural perceptions in the Philippines have been widely found to be associated with emotional strain, including low self-esteem in first-time pregnant adolescents [91], and thereby increasing adolescents' risk of a repeated pregnancy. Cultural norms often apply the stigma of irresponsible behaviour to adolescent pregnancy [91]. Education systems are non-supportive of adolescents to continue their education after their first pregnancy, which resulted in adolescents seeing parenting as the sole aspiration they can pursue in life [91].

The influence of religion on policy and decision-making may have also contributed to the stigma around early pregnancy in the Philippines [13]. Policies and implementation of family planning programs have been hampered by the influence of the Catholic Church on both community groups [92] and health providers [34]. It is also suggested that the influence of the Catholic church has exerted pressure on the country's legislations to reduce the autonomy of adolescent and young women to access postpartum contraceptives [120].

Poor family attitudes on family planning can also negatively affect the delivery of the information needed to shape adolescents' attitudes on family planning [34]. Since parents often rely on health providers and school educators to discuss sexual and reproductive health with their adolescent children, adolescents were found to be not interested in discussing concerns about their reproductive health with their family [121]. Findings from the 2013 Young Adult Fertility and Sexuality Survey showed that nine in every ten adolescent girls had never discussed sex with their families despite their desire to learn from their mothers [7]. Because of lack of communication within a family on family planning, adolescent girls may be confused about the social acceptability of contraceptive use, especially when parents have misconceptions on family planning [121].

Adolescents' misconceptions over family planning also influenced their decision to use contraception. For example, focus group discussions with sexually active adolescents showed condom use as appropriate only for casual and commercial sex and should not be used by married couples and/or those in long term relationships [11]. Adolescent girls from this study also verbalised that most male partners refuse to use condoms because of the perceptions around the spontaneity of the sexual act, whereas adolescent girls themselves often feel unable to refuse unprotected sex for fear of offending their partners [11].

Therefore, despite no data having been published on the extent and magnitude of RP in the Philippines, there is scope for public health concern. Existing national representative data, such as demographic health surveys, can be used to investigate factors and outcomes associated with RP and predict trends over the past few decades. These empirical analyses are essential to facilitate the development of secondary prevention programs. This project covers this important gap in the literature and provides the research needed to develop policies and programs aimed at improving the future health and social status of young Filipino teenage girls.

Prevention programs addressing repeated adolescent pregnancy

There have been international policies and prevention programs to address the needs of teenage mothers and their children. The WHO recommends that health facilities have the capacity to provide family planning services to postpartum adolescent mothers [47]. They also suggest the implementation of structured home visits and health checks [47].

Corcoran and Pillai [54] conducted a review and meta-analysis of different RP prevention programs from 16 articles, which consisted of education programs, home visitations, contraception services, incentive provision, parenting, and integrated/ comprehensive intervention. They found that these programs reduced the incidence of repeated pregnancy by 50% in the first two years following first delivery. The effect of the programs tended to diminish after two years. Meta-regression also showed that quality score significantly explained the heterogeneity among studies. However, this review did not compare effects across types of prevention programs mentioned above. Another review of 77 studies by Aslam and colleagues [122] found that, apart from contraceptive programs, psychosocial interventions – particularly home-based interventions – were preferred by most teenage girls due to increased access to health services, sustained support and repeated contact facilitating behavioural change. The meta-synthesis from this review further suggested that connectedness developed during the peer/mentor support improved self-determination, willingness to delay another pregnancy and to use contraception. Home visitation, which is considered to be a very effective intervention [47, 60, 75], may have a different impact on the reduction of RP compared to other community-based programs. Home visitations also minimised travel for pregnant adolescents and avoided non-compliance to visit health facilities [122].

All the evaluations of secondary prevention programs for adolescent girls have been conducted in developed countries while no studies have been published based on the Philippines and other LMICs. The Philippines launched its Adolescent Youth and Development Program in 2001 targeting youth aged 10-24 [123]. This program aimed to improve service delivery, research, information and education dissemination (IEC) and training among health staff, especially in the community. However, this did not address strategies for RP. Of the several IEC guidelines developed in the Philippines, none had an emphasis on RP prevention [10, 11, 41, 124].

Summary

Adolescent pregnancy remains a major problem among adolescent girls worldwide but especially in low and middle-income countries, like the Philippines. Unlike other countries with decreasing and lower rates, the Philippines have shown a consistent and elevated adolescent fertility rate indicating the potential for persistent adverse impacts of adolescent pregnancy on reproductive and maternal-child health. While the Philippines' adolescent pregnancy epidemic continues to increase the risk of adverse outcomes, the occurrence of another pregnancy during teenage years may further aggravate adverse consequences of early childbearing and parenthood.

The direct health and other health-related outcomes of RP have been explained by some using the dual-developmental crisis framework [66]. Despite the inadequate physical and psychosocial adaptation observed in adolescent girls with RP, maternal adverse effects of RP are not yet well-explored. Several studies have shown adverse childhood effects – including poor birth outcomes, such as low birthweight, preterm labour, neonatal death, and offspring development – after taking into account the confounding effects of socio-economic status, social support, and other demographic characteristics.

Most of the recent evidence suggests a range of intervenable factors affecting RP using the socio-ecological framework. This framework is highly appropriate in this PhD project due to the various facets, across individual, interpersonal and community levels, affecting Filipino adolescents' decision to delay another pregnancy. Among individual factors, history of abortion or miscarriage, depression and frequent sexual intercourse appear to contribute additional risk for RP. Interpersonal predictors, including having an older partner, living with a partner, and having peers who are teenage mothers, also lead to an increased risk of another pregnancy. Conversely, high educational attainment and continuation of school have been found to reduce RP risk.

Despite the lack of evidence in LMICs [63], evidence explaining the socio-cultural contexts of adolescent pregnancy in the Philippines have revealed potential factors. These factors may predispose adolescent girls to have another pregnancy due to the community stigma against contraception and the influence of religion on the implementation of reproductive health programs. However, the literature is still insufficient to rigorously contextualise the burden and risks of repeated adolescent pregnancy in the Philippines. Therefore, it is necessary to explore repeated adolescent pregnancy to establish the evidence-base not only for this country, but also for other LMICs with similar circumstances.

Analysis of nationally representative data to locally evaluate trends and factors can enable local policy makers, program managers and other key stakeholders to develop targeted strategies to contain pregnancy reoccurrence. Identification of RP adverse outcomes will facilitate the implementation of adolescent-focused services to mitigate RP's short- and long-term consequences on maternal and child health. This project explores these aspects of RP while addressing methodological issues identified from current evidence using population-based surveys in the Philippines. The huge scope of these surveys enabled calculation of country-level prevalence and effect estimates. It has also been possible to detect common maternal complications and child developmental delays by both comparing the outcomes of first and second pregnancies of adolescent girls. Finally, links between various socio-ecologic factors have been identified in this study using a rigorous modelling approach outlined in the succeeding chapters.

Adolescent pregnancy is a social and public health problem in most countries around the globe. Every year, 49 in every 1000 girls worldwide give birth to their first infant during the teenage period [39]. The World Health Organization found that two of every ten births across the globe is attributed to adolescent girls aged 10-19 years old [40, 41], which includes 16 million girls aged 15-19 years and 2.5 million girls under age 16 from LMICs [39, 42]. Teenage births in LMICs represent at least 95% of the total births globally [40], and adolescent birth rates in these countries are two to five times higher than in industrialised countries [41].

Globally, the risk of death due to maternal-related causes tends to be higher among adolescents than older women [5]. Complications during adolescent pregnancy are considered as the leading causes of death and disability among 15-19 year olds [42, 43]. The overall burden of disease attributable to pregnancy and childbirth is 23% [40, 41], and 15% of this has been attributed to teenage pregnancies [44]. A systematic analysis of the global burden of disease for young people aged 10-24 has found maternal sepsis to be the 6th leading cause of disability-adjusted life years (DALY)s among 15-19 (3.1%) and 20-24 year olds (3.7%) [45]. In these two age groups, maternal conditions were the 4th leading cause of disability and 3rd leading cause of DALYs [43] worldwide and within each region [45, 46]. Therefore, early childbearing can cause greater adverse physical outcomes in adolescents. These include pregnancy and postpartum complications and maternal death, which may occur especially if there is lack of access to antenatal and intrapartum services [40, 47].

There are also socioeconomic and psychosocial implications which may impact transitions into adulthood [47], leading to risky behaviours and social disadvantage. Teenage women from low socio-economic status who experience an early pregnancy tend not to complete secondary school education [47-49]. Lower educational attainment further prevents these adolescents from reaching their individual goals, and this may lead to a continuous cycle of poverty [50, 51]. Adolescent motherhood has also been found to be associated with greater risk of depression, suicidal ideation, as well as use of illicit drugs and other substances [52]. Studies have also shown that parenting and pregnant adolescents are at risk of domestic violence either as victim or perpetrator [53].

While steps have been taken to address the issue in high-income countries, adolescent pregnancy remains a public health concern in LMICs. The latest global disease burden reported maternal disorders as the 11th leading cause of death among 10-19 year old adolescents in LMICs [46]. One of the countries with some of the most concerning statistics is the Philippines. The WHO reported that the adolescent fertility rate of 53 births per 1000 in the Philippines was one of the three highest in the West Pacific Region, next to Laos and Cambodia [5, 39]. The Philippines is one of six countries with the highest teen pregnancy rate in the ASEAN region [55] and the only country in the Asia-Pacific with no significant decrease in its adolescent fertility rate in the last 20 years [6, 9]. Indeed, some reports suggest a doubling of births and pregnancies among teenagers from 6.3% in 1994 to 13.6% in 2013 [7]. Teenage pregnancy continues to cause maternal-related morbidity and mortality in this country, clearly reflected in this country's mortality figures [56]. The Philippine Statistics Authority reports that maternal deaths among Filipino teenagers rose from 96/100,000 livebirths in 2000 to 164/100,000 livebirths in 2010 [57]. This suggests the severity of the problem as well as the poor reproductive health conditions of Filipino adolescents.

While the Philippines is still in its initial efforts to address the problem of adolescent pregnancies, an even more concerning issue is the case of teenagers who conceive again soon after an early pregnancy. This is referred to as **repeated adolescent pregnancy (RP)**. This thesis, therefore, investigates RP by examining the existing evidence on RP, and contextualising the need for a new investigation in a LMIC such as the Philippines, as presented in this chapter.

Chapter 3: METHODOLOGY

This chapter presents the methodology for this PhD project, which includes meta-analytical reviews and original analyses using existing data. I will first describe methods used to conduct the systematic review and meta-analyses. Afterwards, I will discuss in detail the research designs of the two Philippine data sources used for this study: the Philippine National Demographic and Health Surveys (NDHS), and the Cebu Longitudinal Health and Nutrition Survey (CLHNS). This chapter also presents a description of the risk factors and outcome variables measured and the statistical analyses used.

Meta-analytic review

This section describes the review processes done to systematically analyse and quantitatively synthesise the effect estimates of a particular exposure to a particular outcome from studies which have relevant and adequate information. Meta-analytic techniques were specifically applied to synthesise evidence on RP predictors. Due to lack of eligible and robust studies, systematic review and meta-analysis on RP outcomes was not done.

I searched electronic databases using different key words for published studies. To improve the scope of my search strategy, I went through reference lists of various discussion and review papers. I screened articles identified by the search using the PRISMA guidelines; using a set of eligibility criteria, I conducted titles and abstracts screening followed by detailed full-text screening to carefully assess each article's relevance and appropriateness for the review (see *Papers 6.1 and 7.1* for details). In general, I excluded erratum articles, review papers and studies which used the same datasets.

At least three reviewers independently extracted the study characteristics, participant information, results, and limitations from each eligible research article. Study quality was obtained using validated tools, such as the US National Institutes of Health's tool for observational studies and the Quality Assessment Tool for Quantitative Studies of Effective Public Health Practice Project [125, 126], producing a quality score applied in the meta-analytic model to account for bias [127]. Inconsistencies were discussed and finalised before analysis. Data obtained from eligible studies underwent narrative analysis which allowed grouping based on methods, exposure variables and result characteristics.

I conducted meta-analysis using random-effects and quality-effects models incorporated in MetaXL and STATA version 14 software. I applied random-effects meta-analysis to pool the effect sizes with the assumption of heterogeneity among studies [126, 128-130]. On the other hand, I used quality-effects meta-analysis, as an alternate model, to reduce the variance of the pooled estimate and provide more appropriate weights through the incorporation of the quality score of each study [130, 131]. Level of heterogeneity was determined using Cochran's Q at 0.10 level of error and the I^2 statistic. Publication bias was evaluated using Egger's and Begg's tests while considering small study effects [129, 130].

To determine the possible sources of heterogeneity among studies, random-effects meta-regression was used followed by subgroup and sensitivity analyses. Random-effects meta-regression uses the residual maximum likelihood algorithm which maximises the residual log likelihood and approximates residual heterogeneity, defined as the study variance not explained by the covariates while assuming that the true effects follow a normal distribution [126, 129, 132, 133]. It also accounts for the degrees of freedom for categorical variables which prevents underestimation of regression coefficients [129, 134-136]. Knapp-Hartung variance estimator was applied to calculate the p-values of each covariate while preventing false-positive results [137]. Moreover, multiplicity adjustments with 10,000 permutations was also done to avoid Type-1 error related to the small number of studies of the meta-regression coefficients [134].

The Philippines National Demographic Health Surveys (NDHS)

The NDHS (1993, 1998, 2003, 2008 and 2013) is a series of cross-sectional surveys, conducted every five years since 1993 to measure the health status of households, women and children. All surveys used nationally representative samples, recruited through a two-stage or three-stage stratified random sampling with rural and urban stratifications, using the Philippines census as the sampling frame [9, 138-141]. The first stage involved identification of regionally distributed primary sampling units which ranged from 750-819 with rural and urban stratifications (see **Table S. 1**). The last stage managed to systematically select 17-20 housing units having a maximum of three households per unit. From the selected households, all women of reproductive age (15-49 years old) were interviewed including the household head. Women were individually asked about their socio-demographic characteristics, reproductive health, marital status, child/ infant health status, HIV/AIDS awareness, history and knowledge on infectious diseases, as well as domestic violence. The questionnaire used underwent inter-agency expert validation and pre-testing in selected provinces.

There is an increasing participation among adolescents and young adults (15-24 years old) across the five survey years with the highest percent distribution particularly among 15-19 years old compared to other groups. The sample across all studies were mostly (at least 40%) in high school for adolescents aged 15-19 years. The majority of the teenagers were never married, followed by being in live-in status (during the 2003, 2008 and 2013 surveys) or married status (1993 and 1998 surveys). On the other hand, most of the 20-24 year old women from 1993 (38.4%) to 2008 (26.8%) were married while those during the 2013 survey were in live-in status (23.0%).

Power analyses showed acceptable minimum detectable effect sizes for the NDHS. A total sample of 1,320 adolescents aged 15-19 ranging from 216 to 339 per survey year suggested a minimum detectable OR of 1.5 and RP rate of 7.71% at >80% power with 5% two-sided alpha. This is actually lower than the conservative effect sizes which are 1.72 and 20% based on most current literature [14-16]. On the other hand, a sample of 46,888 women 15-49 years old (ranging from 8,919 to 10,487 at each time point) showed a minimum detectable OR of <1.2. Weight adjustments during analysis were applied due to large differences in sample size between these two groups. A design effect was not included in the analysis because of its low or negligible influence (almost near to 1.0, ranging from 1.17 to 1.27) [9, 138-141].

The Cebu Longitudinal Health and Nutrition Survey (CLHNS)

The CLHNS [117] is a three-generation prospective community-based cohort in Cebu, Philippines which aimed to explore maternal and child health, demographic and nutrition-related issues. This study also aimed to investigate the different proximal health behaviours (i.e. birth spacing practice and attitudes, family planning, physical functioning and parent-child relationships) predictive of health outcomes both of the mother and her children. CLHNS is approved and funded by the National Institutes of Health in the United States.

The baseline data collection was conducted during the second to third trimester of pregnancy, followed by an immediate postpartum interview, and bimonthly interviews for 24 months. Follow-ups were then conducted in 1991, 1994, 1998, 2002, 2005, 2007 and 2009. During the 2009 follow-up, data were only collected among index children and their offspring.

The mothers were followed-up until 2015 while index children were followed through adolescence and into young adulthood. Offspring of the index children were also tracked by the study enabling intergenerational analysis among the cohort participants. The succeeding section describes the remaining sample and data collected in each follow-up, which can be also found in its published cohort profile [117].

Data collection procedure

This project only used the survey data collected from 1983 to 1986. A baseline survey was conducted between May 1983 and April 1984 using a single stage cluster sampling of 33 barangays. All pregnant women from sample households were initially asked to participate. However, only those who ended with a livebirth were followed-up. A total of 3327 women from 2600 households were recruited while only 3080 women with singleton deliveries were followed-up bimonthly for 24 months after birth, wherein 2565 women and 2462 index children remained.

From this sample, I extracted 1284 mothers aged <25 years old at baseline. A total of 1120 and 1084 showed complete mother-offspring data at 12 and 24 months respectively, indicating high retention rate of approximate 92%. Respondents who remained in the study mostly experienced lower educational attainment, higher parity, and were from poorer and rural communities.

Individual and household demographics and socio-economic status were collected starting at baseline using a validated questionnaire. Birth-related information such as birthweight, gestational age and disease history were obtained 2-4 weeks after delivery. Birthweights were obtained from the health facilities where mothers gave birth through the assistance of midwives from the community.

Bimonthly follow-up data included maternal and offspring diet, morbidity and anthropometry. Anthropometric measurements were collected using calibrated instruments. Data collectors were trained and assessed for proficiency using the Habicht procedure [142] where 10 mother-offspring dyads were hired and brought to a clinic-like environment during the data collectors' training. Each pair were measured twice by a supervisor and an observer to assess the accuracy and precision by comparing their measurement with those obtained by the trainees.

Main Measures

Repeated adolescent pregnancy

Adolescents were considered to have experienced a repeated pregnancy (RP) if they have had at least two pregnancies (resulting in a live birth or pregnancy loss) between 15 and 19 years of age. This outcome was obtained from adolescents' pregnancy history collected using a self-report questionnaire. This data has a minimal risk of recall bias as pregnancy can be a significant life event for adolescents and can easily be recalled. The DHS questionnaire used to obtain this information allows validation through random repetition of the question regarding the number of pregnancies.

Children in the second (or repeated) pregnancy order is considered as the main exposure for all the above mentioned health outcomes. This data, like RP, is self-reported information. A repeated birth can be preceded by a livebirth, abortion, miscarriage or stillbirth. This variable was used to assess the effect of RP on maternal outcomes. RP was also considered as a count variable by considering the number of past pregnancies the sample had in relation to the date expected of delivery of the index child from the CLHNS data.

Health outcomes

Occurrence of maternal complications pertains to the self-reported problems occurring during pregnancy and at the time of birth. Problems during pregnancy included vaginal bleeding, headache, dizziness, blurred vision, swollen face, swollen hands or feet, paleness/anaemia, body pain, irregular blood pressure/sugar imbalance, vomiting, asthma/breathing difficulty, cold/cough/flu/fever, and urinary tract infection. On the other hand, problems during delivery included long labour (more than 12 hours), excessive bleeding, high fever with bad-smelling vaginal discharge, and loss of consciousness.

I assessed child health using birthweight and length-for-age z score. *Low birthweight* was defined as a newborn weighing less than 2500 grams. In my analysis, this outcome was considered as binary, either normal or low birthweight. *Length-for-age z score (LAZ)* was obtained using the WHO's growth reference, and the age in months and length in centimetres of the child. Using LAZ, I defined stunting as LAZ less than -2 either at age 12 or 24 months. I also analysed the persistence between 12 and 24 months. Persistence was classified into four types: persistent (stunted at age 12 and 24 months), recovered (stunted only at age 12 months), late incident (stunted only at age 24 months) and none (neither at age 12 and 24 months) [143]. I also used LAZ as a continuous outcome to show the level of influence of RP on LAZ score and to facilitate mediation analysis.

Risk factors

First pregnancy history. The experience of the adolescent mother during her first pregnancy consists of intention, prenatal check-up, antenatal visits, use of skilled birth attendants (or skilled birth deliveries), facility-based deliveries (FBD) and birth outcome which were all based on self-report. Intention of the first pregnancy is categorised as intended, wanted later and not intended at all. Prenatal check-up is referred to as the person who attended the prenatal check-up which is either a health professional (i.e. doctor, nurse or midwife) or a traditional birth attendant (or none). Antenatal visits was dichotomised (≥4 or <4 visits). Type of birth attendants is defined as the person who assisted the adolescent during delivery while FBD is the place where the delivery occurred (i.e. health facility or home). Birth outcome pertains to the outcome of the pregnancy which is either a livebirth, abortion, miscarriage or stillbirth.

Use of modern contraception*.* This refers to the use of a modern type of contraception as described by the WHO [144], which includes oral pharmaceuticals (combined oral contraceptives or progestogen-only pills), subdermal implants, condoms, injectables, patches, intrauterine devices, sterilization, lactational amenorrhea method, standard days method, basal body temperature method, symptothermal method or emergency contraception. Depending on the available data in each dataset, the timing of contraceptive use is measured as either current use or before the occurrence of the repeat pregnancy.

Inter-pregnancy interval. This is defined as the number of months between the first and the second pregnancy.

Feeding practice. This considers four feeding practice indicators which include breastfeeding within 24 hours after delivery, consistent breastfeeding for 6 months, breastfeeding at 12 months, and introduction of semi-solid and/or solid foods between 6 – 8 months. I derived these indicators using the bimonthly CLHNS feeding data. Responses were cross-checked using the 24-hour and 7-day diet recall of the index child.

Demographics. Maternal age was considered both as continuous and categorical. I grouped age into two and three categories. Two categories include 15-19 years old and 20-24 years old while three categories include 15-19 years old, 20-24 years old and 25-44 years old. Partner's age was categorised into four groups: '15-19', '20-24', '25-29', and '≥30'.

Geographical location was characterised using the type of residence and region of residence. Type of residence was either rural or urban while region of residence was Luzon, Visayas or Mindanao, which is based on the three main island groups of the Philippines.

I measured marital status as single, married or live-in/de facto status. Number of intimate partners pertained to the number of sexual partners at the time of interview. This measure was further dichotomised to one and more than one partners.

Socio-economic status. This was represented through education, household income and employment status (i.e. employed or unemployed). Instead of using all levels of education, I categorised maternal and partner's education completion/non-completion of secondary education. In NDHS, household income was measured using wealth index [111], grouped into three as lower, middle and upper income class. In CLHNS, I used the monthly household income from all sources and created three income classes using the Cebu's average household income [145, 146] to come up with the income brackets for each class.

Statistical analysis and modelling approaches

Multivariate regression analyses

Multivariate logistic regression was used to measure the association of a binary dependent variable (i.e. presence and absence of the outcome) with multiple independent variables [147]. In this analysis, the outcome variable was assumed to have a binomial distribution conditional on the values of the exposures. This analysis produces effect estimates in Odds Ratios (OR) with 95% Confidence Intervals (95%CI) in each predictor incorporated in the model. Issues of non-linearity and multi-collinearity were also addressed by transformations, graphical investigations and evaluation of variance-inflation factor. For NDHS dataset, denormalised survey weights were applied to account for the clustering per region and enumeration area.

Apart from logistic regression, I used multivariate linear and multinomial logistic regression to further explore the relationship between stunting and RP while accounting for confounders. Linear regression was conducted using LAZ, which is a continuous outcome after checking for independence, linearity, homoscedasticity and normality of the error distribution [148]. Instead of OR, linear regression analyses produces mean difference in reference to a unit increase in the exposure. Multinomial logistic regression was used in analysing persistence which has multiple (i.e. four) categories [149]. This is the extension of logistic regression which produces estimates for all predictors in each of the categories of the outcome (i.e. persistence).

My predictive models used both a stepwise and backward stepwise approach. Stepwise modelling considers a 0.20 p-value cut off from univariate analyses and adjusted analyses of progressively adding groups of predictors into the model. On the other hand, backward stepwise modelling starts with a full model (i.e. all predictors are in the model) and gradually removes predictors using the same p-value cut-off. All models created during the analyses were tested for goodness of fit using Akaike's and Schwarz's Bayesian information criteria and adjusted R^2 [150]. I came up with my final models by comparing the statistics from these diagnostic tests.

I included interaction terms to test effect modifications and effect differences by age (both as continuous and categorical) and inter-pregnancy interval (IPI). I also conducted interaction tests before proceeding with mediation tests to confirm linearity and homogeneity of error variance across age categories.

Mediation analysis

Parity was suggested as a potential mediator between age and stunting [86]. I tested this hypothesis using the CLHNS dataset by measuring the direct, indirect and total effects of repeated pregnancy on stunting outcomes via low birthweight and feeding practice. I used the *binary_mediation* macro produced by STATA 14, to obtain indirect effects, direct effects, total effects and proportion mediated through repeated pregnancy [151]. Adapting the standard Baron and Kenny set of equations, this macro allowed us to use both binary and continuous outcomes and produce standardised coefficients with 95% confidence intervals after bootstrapping with 10,000 simulations [152].

Ethical Considerations

This project entails minimal risk to its respondents. Survey datasets used do not contain information which eliminates the anonymity of the respondents. All datasets were approved to be used for analysis by the United States Agency for International Development, and the University of North Carolina-Carolina Population Center, which have the copyright of the NDHS and CLHNS respectively. The protocol of this project has already been approved by the University of Queensland, School of Public Health Ethics Review Board.

RESULTS

The succeeding chapters describe the results of this PhD project, through a series of studies and meta-analytical reviews. These chapters examine (1) the trend of repeated pregnancies and births among adolescents in the Philippines, (2) maternal outcomes and stunting in subsequent children of adolescents with repeated pregnancies, (3) various factors associated with repeated adolescent pregnancy, and (4) a systematic review about community health worker visitation as an intervention to prevent repeat pregnancy.

The results section presents findings on trends and outcomes to demonstrate the magnitude and burden of repeated adolescent pregnancy (RP). After establishing RPs public health implications, I discuss important risk factors to consider in designing future preventative interventions.

Each chapter consists of papers which have been published or submitted for publication. The findings and implications from these four chapters are integrated in a summative discussion presented in **Chapter 8**.

Chapter 4: Twenty-year trend of repeated pregnancies and births among adolescents in the Philippines

A recent global report shows that the Philippines have not exhibited a reduction in adolescent fertility in the past two decades [6]. The Philippines Vital statistics data found a minimal reduction in ≤19 year olds who had more than two livebirths from 2000 to 2012 [19-21]. However, these data underestimate the true magnitude of repeated adolescent pregnancy since these only include adolescent mothers who successfully had livebirths, and exclude stillbirths, miscarriages, and abortions. I address this data gap by examining pregnancy history instead of birth history.

This chapter investigates the trends of repeated pregnancy and birth among adolescents from 1993 to 2013 using the Philippine National Demographic and Health Surveys (NDHS). This national representative survey allows us to produce robust national-level estimates disaggregated by age, region, and type of residence, as shown in *Paper 4.1*.

4.1 Trends of Repeated Pregnancy and Birth among Adolescents

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Title:

Trends in repeated pregnancy among adolescents in the Philippines from 1993 to 2013

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Abstract

Objective: The extent of repeated pregnancy (RP) and repeated birth (RB) among adolescents aged 15–19 is still unknown in the Philippines despite the health and socio-economic consequences. This study aims to investigate the RP and RB prevalence trends in the Philippines from 1993-2013.

Methods: A total of 7,091 women aged 15–24 who experienced at least one pregnancy were captured in the Philippine demographic health surveys from 1993–2013. Annual RP and RB prevalence per age group in three and five categories were calculated and stratified by region, type of residence and wealth index. Cochran–Armitage tests and multivariate logistic regression were applied to determine trend estimates.

Results: Compared to women aged 19–21 years and 22–24 years, for which decreasing patterns were found, RP ([Adjusted Odds ratio (AOR =0.96; 95%Confidence interval (CI) =0.82–1.11) and RB (AOR=0.90; CI=0.73–1.10) trends among 15–18 year olds showed negligible reduction over the 20 years. From a baseline prevalence of 20.39% in 1993, the prevalence of RP among adolescents had only reduced to 18.06% by 2013. Moreover, the prevalence of RB showed a negligible decline from 8.49% in 1993 to 7.80% in 2013. Although RP and RB prevalence were generally found more elevated in poorer communities, no differences in trends were noted across wealth quintiles.

Conclusion: For two decades, the Philippines has shown a constant and considerably high RP prevalence. Further investigation, not only in the Philippines but also in other developing countries, is necessary to enable development of secondary prevention programs.

Plain English Summary

Despite high and stable levels of adolescent fertility in the Philippines, no specific research has been conducted to specifically measure the trend and magnitude of repeated adolescent pregnancy, which is defined as an adolescent who has had at least two pregnancies. Repeated pregnancy, therefore needs to be investigated as it reflects not only the reproductive health of adolescent mothers but also disparities in service delivery of health, education and welfare support to adolescents after their first pregnancy.

I used the Philippine Demographic and Health Surveys to sample 7,091 women aged 15–24 who experienced at least one pregnancy. Annual RP and RB prevalence per age group in three and five categories were calculated and stratified by region, type of residence and wealth quintile. Trends were statistically analysed using Cochran–Armitage tests and multivariate logistic regression.

While a decline was observed in 19–21 and 22–24 year olds, we found a constant prevalence of one in every five in 15–18 years old from 1993–2013. This trend was evident across all regions, types of residence and socio-economic status. My analysis also found that those from the poorest wealth quintile demonstrated a heightened risk of repeated pregnancy compared to other quintiles. The non-decreasing prevalence trend of repeated pregnancy among adolescents indicated the need for secondary prevention programs particularly for the poorest households. Epidemiological investigations are also necessary to explore the causes and impact of repeated pregnancy on maternal, child and neonatal health, not only in the Philippines, but also among other low- and middle-income countries.

Introduction

The adolescent pregnancy epidemic in the Philippines has been acknowledged as one of the worst in the Western Pacific Region [1] with a recent prevalence of 13.6% among 15–19 year olds. The Philippines is the only country in this region with no significant decline in adolescent fertility in the past decades [2] from 56 per 1,000 in 1973 to 57 per 1,000 in 2013 [2,3]. In order to address this entrenched public health issue, preventive policies and programs have been implemented [4,5], and epidemiological studies have been developed to provide evidence of the current sexual health and behaviour of Filipino adolescents [6]. However, these measures have put little emphasis on the more serious problem of repeated adolescent pregnancies.

Repeated adolescent pregnancy, which is defined as a subsequent pregnancy among adolescents aged 10–19 years [7] is known to affect around 18% of adolescent mothers in the USA [7], Europe [8], and Australia[9]. Despite the evident chance of repeated adolescent pregnancy especially within two years postpartum [10], current research is unable to clearly establish its magnitude in developing countries such as the Philippines, nor how the trends have changed across time [11-13]. Although a World Health Organization (WHO) multi-country report [14] discussed the relationship between age and parity among Filipino adolescents, this study did not assess the prevalence of multi parity as its primary measure.

As a marker for adolescent reproductive health, repeated pregnancy reflects health disparities particularly among the disadvantaged adolescent population. Repeated pregnancy also indicates poor distribution and unequal access to reproductive health services [15] and inadequate service capacity of individual localities. It relates to low educational attainment, limited employment opportunities and poverty among adolescent mothers [15,16]. It has been shown that repeated adolescent pregnancy leads to an increase in national health and welfare expenditure as a consequence of the long-term dependency of adolescents and their families on government assistance [15,17].

An increasing trend of adolescent sexual activity [3] ongoing poor compliance with modern contraceptives [2,18] and inadequate use of family planning services all suggest that repeated adolescent pregnancy is highly prevalent in the Philippines [12]. Analysis of existing nationally representative data can be helpful in evaluating the extent of this public health problem. In this study, we aim to determine the prevalence of repeated pregnancies and births among adolescents and young adults from a series of national surveys conducted between 1993 and 2013. Moreover, we intend to analyse the trend of repeated pregnancies and births by age groupings and potential macro-level confounders across two decades, with resulting trends perhaps reflecting the effectiveness of existing policies and programs in addressing this under-recognized adolescent health problem.

Methods

Population and sample

This study used the Philippine Demographic and Health Survey (DHS) from 1993, 1998, 2003, 2008, and 2013 which are cross-sectional surveys conducted every five years. This nationally representative survey involved a multi-stage sampling design up to the household level with enumeration areas distributed by region and type of residence using the most recent national census as its sampling frame. All women in the selected households which includes adolescents aged 15–19 years and young adults aged 20–24 years were interviewed using the Individual Woman's Questionnaire. This survey therefore excludes adolescents aged below 15 years. As shown in Appendix A, the majority of the survey sample belonged to these age brackets which we will refer to as adolescents for the succeeding parts of this paper.

Outcome and socio-geographic measures

Repeated adolescent pregnancy/birth. An adolescent aged 15–19 years was considered as having experienced repeated pregnancy (RP) if she had experienced at least two pregnancies, including current pregnancies, which either resulted in a live birth and/or pregnancy loss. A case of repeated birth (RB) was defined as an adolescent with at least two live births. These definitions were adapted from related review papers [8] and the Centers for Disease Control and Prevention [7].

Year. Survey year was considered as a continuous variable in the analysis to measure the trend because of equal intervals between survey years. Thus, each unit increase in year variable translates to an actual five-year increase.

Age. Respondents were categorized by age into three and five groups. The three age groups include “15–18” which considers the legal age of consent (18) in the Philippines, “19–21” as the transition period, and “22–24” as young adults [19]. In sensitivity analysis we further subdivided age into five groups (i.e. “15–16”, “17–18”, “19–20”, “21–22”, and “22–24”) to analyse in detail the trends per age.

Socio-geographic variables. Region refers to the three main island groups: Luzon, Visayas, and Mindanao. We disaggregated and compared all estimates by region since each island group has unique geographical and cultural characteristics. Further disaggregation per administrative region was not pursued, as the number of administrative regions had increased during the 1998. Type of residence was either rural or urban area where the respondent resided at the time of the survey. Based on their household’s wealth score, adolescents were grouped into the household wealth quintiles “richest”, “richer”, “middle”, “poorer”, and “poorest” class.

Analyses

We calculated the mean, standard deviation and prevalence rate of RP and RB per year per age group. RP prevalence was calculated by dividing the number of adolescents with RP and the number of adolescents who experienced at least one pregnancy (including those currently pregnant) multiplied by 100. RB prevalence on the other hand was calculated by dividing the number of adolescents with RB and the number of adolescents who experienced at least one livebirth multiplied by 100. Deformalized survey weights were applied while calculating the prevalence.

We used the *ptrendi* package in Stata13 to perform Cochran–Armitage tests to determine the prevalence trend per age group using the chi-square statistic and meeting the assumptions of an additive model. Cochran–Armitage test is a modified Pearson's chi-square test which assesses the association between binary (i.e. RP and RB) and ordinal (i.e. year and age) categories. Multivariate logistic regression analysis with interaction effects for age (i.e. age groups using both three and five categories) and year was conducted while using repeated pregnancy and birth as binary outcome variables (i.e. yes or no). We measured the trend between two consecutive survey years to identify which periods had significant changes in prevalence. In addition, we analysed trends using year and socio-geographic (i.e. region, type of residence, and wealth index) interaction per age group. For the purpose of this analysis, we used the three category age group as this was the only categorization which allowed a sufficient number of cases.

Results

Among women aged 15–24 years with at least one pregnancy (n=7,091), a large proportion (53.3%) were found among the 22–24 year olds. Despite the small proportion of adolescents captured by the surveys, the proportion of 15–18 year olds reported in the survey has increased over time from 7.64% (n=107) in 1993 to 15.55% (n=213) in 2013 (*see* Table 4.1. 1*).*

Trend analysis per age group

Cochran–Armitage tests showed an overall decrease in the trend of RP (Chi2=127.60; p<0.001) across twenty years among the 15–24 years old from a weighted RP prevalence ($WtPrev_{RP}$) of 58.12% in 1993 to 40.58% in 2013. There was also a general RB (Chi2=100.90; p<0.001) reduction from weighted RB prevalence ($WtPrev_{RB}$) of 51.25% to 35.66%. However, within age groupings this decline was not observed among 15–18 years olds. In Figure 4.1. 1, we only found a slight decrease in RP prevalence from 20.39% in 1993 to 18.06% in 2013. RB prevalence also presented a minimal change with 0.69 decline among 15–18 and 0.80 decline among 17–18 years olds in this 20-year period (*see* Figure 4.1. 2). Further observations among 17–18 years olds showed a similar RP trend from 22.26% to 18.52%.

Similar results were found in the regression analysis. The RP trend among 15–18 year olds remained virtually unchanged across all surveys from 1993 to 2013 [Odds ratio (OR) =0.93; 95% Confidence interval (CI) =0.81–1.07]. There was a similar pattern of RB trend in this age group (OR=0.87; CI=0.72–1.06) following an apparent increase in prevalence from 1993–1998 (OR=3.29; CI=1.25–8.62). On the other hand, the older age groups showed a significant decline both for RP and RB with unadjusted ORs ranging from 0.83 to 0.87 (*see* Table 4.1. 2*).* Analyses using five age categories showed no significant difference in the trends previously described. Trends among 15–16 and 17–18 year old adolescents remained unchanged, whereas a decreasing trend was apparent for those aged 19–20, 21–22 and 23–24.

Adjustments for regions, types of residence and wealth quintile suggested that the trends were not confounded by these factors across all age groups. Interestingly, wealth index was strongly associated with RP and RB as adolescents from the poorest quintile had shown higher odds in reference to richest quintile (OR_{RP}=5.41, CI=4.31–6.78; OR_{RB}=5.36, CI=4.17–6.89). Calculation of weighted prevalence confirmed this association with a $WtPrev_{RP}$ of 59.60% and $WtPrev_{RB}$ of 52.50%.

Change of prevalence between two consecutive survey years was also analysed using the three age categories. We found that there was a decrease in RP prevalence among 15–18 from 1998–2003 (OR=0.52; CI=0.28–0.99), and among 22–24 from 1993–1998 (OR=0.77; CI=0.61–0.97) and 2003–2008 (OR=0.71; CI=0.58–0.88). A drop in RB prevalence was also found among 15–18 from 1998–2003 (OR=0.32; OR=0.13–0.81); and among 22–24 from 1993–1998 (OR=0.74; CI=0.58–0.93).

Trend per socio-geographic variable per age group

The constant RP trend among 15–18 and the decreasing RP trend among 22–24 were found in all regions, types of residence and wealth quintiles (*see* Table 4.1. 3*).* On the other hand, the decline of RP decline among 19–21 was only consistent across regions and types of residence. Only the poorer households showed a 20-year reduction when compared to the other four quintiles.

A similar pattern was observed for RB trend among those aged between 15–18 and 22–24. Unlike RP, the trend for RB among 19–21 year olds was inconsistent across the three socio-geographic variables. The decreasing trend was only found in Visayas and Mindanao region, rural communities, and poor wealth quintiles *(see* Figure 4.1. 3*).*

In each age group, we also conducted adjusted Wald tests to measure the difference of trend estimates between the categories of each socio-geographic variable. No differences were observed for 15–18. For 19–21, differences were only found between the RP trend estimates of poorest and poorer quintiles, and between the RB trend estimates rural and urban communities. For 22–24, differences between the trend estimates of poorest and richest, and between poorer and richest were found both for RP and RB.

Discussions

Despite the declining trends of RP and RB in older age groups, the prevalence among adolescents younger than 18 years showed no decrease across 20 years of data, remaining stable across all regions, types of residence, and wealth quintiles. The prevalence was high with approximately one in every five adolescents aged 15–18 years with a history of pregnancy experiencing RP while one in every ten of those who had a livebirth experienced RB.

While the decreasing RP and RB trend among young adults can likely be attributed to their improved contraceptive use [20] and awareness of and participation in family planning (FP) strategies [3,21]. The unchanged trend among adolescents may result from the unique socio-cultural characteristics and FP policies in the Philippines, wherein adolescents are prevented from accessing FP services, even after their first pregnancy. One of the possible explanations for this finding is that the strong influence of the Catholic church at the local level may have affected the health seeking behaviour and the implementation of reproductive health programs among adolescents [22,23].

Unclear and restricted health and health-related policies for adolescent mothers may also play a role. The initial adolescent health policy in the Philippines [24], which aimed to reduce unwanted pregnancies and provide adolescent-friendly health services, did not include strategies for dealing with the prevention of secondary pregnancies [25,26]. This may have led to adolescents being discouraged to access essential health information and use birth control methods [23,27].

Despite emphasizing the importance of health promotion and behavioural change, a recently introduced national law (Responsible Parenthood and Reproductive Health

Act of 2012 or RH Law) and framework [4], did not embrace specific programmatic actions to address RP. The RH Law still prevents minors (i.e. below 18 years old) from accessing modern methods of contraception without parental consent and does not exempt adolescent mothers and adolescents who experienced miscarriage [28]. This policy restriction has already been found as a deterrent for adolescents to access contraceptives and counselling services in a review of evidence from 16 developing countries [29]. This study suggests that despite the availability of contraception, most of these developing countries retain barriers and restrictions towards the use of birth control methods, particularly among unmarried adolescents. In the context of this social and political environment, the RP/RB trends showed in this paper can be expected to continue for several years to come not only in the Philippines but also in other developing countries.

The role and reach of secondary prevention programs must be clarified due to the limited access to appropriate postnatal services (e.g. contraception, counselling, and educational support) for adolescent mothers. Health workers may also need to be trained to address the unique psychosocial characteristics and support the challenging developmental transition of very young mothers by enhancing adolescents' readiness and decision-making abilities to delay another pregnancy and/or use modern family planning methods. Given the high rate of unmet need for modern contraception among married adolescents [21], policy initiatives/reforms such as providing exemption on contraception to adolescent mothers may be needed to achieve a reduction in the trend seen in this paper.

Our findings also suggest that prevention programs aimed at those from the poorest quintile may be warranted due to the high RP/RB prevalence among this group. In the Philippines and other low- and middle-income countries (LMICs), attempts to reach out to households from the poorest sector have been undertaken through the Conditional Cash Transfer (CCT) Program [30,31]. For example, the CCT program in Mexico has been found to indirectly reduce adolescent pregnancy and increase contraceptive use among adolescents and young adults [31]. The potential of cash incentive schemes can also be used as an opportunity to monitor and provide prevention programs to adolescent mothers, particularly within 24 months after their first pregnancy [10].

Our study uniquely explores the status of repeated pregnancy and birth in LMICs in the Asia-pacific Region. Most published reports on this topic are primarily from the USA, Europe, and Australia [32]. Of the few reports identified from LMICs, many used birth order (i.e. 2nd order or higher) and a different denominator (i.e. total number of adolescents) in the computation of prevalence. Despite the availability of possible data sources among LMICs [33], few studies have attempted to look specifically at the distribution of adolescents and young adults with RP/RB. Most of the reports available may include vital statistics which is limited to those only with livebirths and does not necessarily account for previous unsuccessful pregnancies.

By placing RP as an issue of crucial importance to the public health especially of LMICs, our paper makes a significant contribution to the literature calling for improvement of sexual and reproductive health of adolescents. The Global Strategy for Adolescent Health for 2030 recognized childbirth and pregnancy complications as one of the two leading causes of death among 15–19 year old girls [34]—addressing RP would help to reduce this. The absence of a reduction in RP trend over 20 years that we identified, signals the need for secondary prevention programs in line with WHO recommendations [35].

This study finds strength in our use of nationally-representative individual datasets instead of aggregate estimates. This prevents the risk of producing results affected by the ecological fallacy, particularly in the analysis of year-age interaction. Furthermore, we were able to perform more thorough analyses such as the adjustment of trend estimates for confounders (i.e. wealth quintile, region, and type of residence).

Limitations

Our study also has limitations. Recall bias and under-reporting are likely to produce bias in any surveys covering information of a sensitive nature. Insufficient record validation is common across the DHS surveys from all countries. However, the DHS' survey procedure enables cross-checking through repeated questions during the interview to reduce the effect of this validation issue. Additionally, our findings may not be comparable to longitudinal studies from developed countries that defined RP as an adolescent who became pregnant within 12–24 months of her first pregnancy/ delivery.

Future research

In addition to cross-sectional analyses that measure RP prevalence, epidemiological investigations are needed to explore the causes and outcomes of RP. Studies conducted in LMICs may identify different associations and dynamics due to the psychosocial and cultural characteristics of and attitudes towards adolescent mothers in these countries. This type of study not only directs the development of specialized perinatal care, and psychosocial and welfare support but also places priority on those adolescents with RP.

A multi-country analysis would also be beneficial in obtaining a broader RP status especially in countries with similar characteristics. This would help international organizations to implement immediate action for RP in a global approach and prioritize countries with a high RP burden. Additionally, projection of RP prevalence at least until 2030 using country-level determinants such as contraceptive prevalence, poverty, literacy, and maternal-child mortality rates, may facilitate target setting for this potential adolescent reproductive health indicator.

Conclusion

There is a constant trend of one in every five adolescent mothers in the Philippines experiencing repeated pregnancy from 1993–2013 (across all regions, type of residence, and socio-economic status). These findings indicate the need for secondary prevention programs, particularly among the poorest households. Epidemiological investigations are also necessary to explore the causes and impacts of repeated pregnancy on maternal, child, and neonatal health in the Philippines and other low- and middle-income countries.

Declarations

Ethics approval: This study underwent an expedited review and was approved by the University of Queensland – School of Public Health Ethics Committee on April 11 2016.

Consent for publication: Not applicable.

Availability of supporting data: The datasets analyzed during the current study are not publicly available but can be requested from the DHS Program data managers.

Competing Interests: The authors have no conflicts of interest to disclose. The authors have no financial relationships relevant to this article to disclose.

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Authors' contributions: JM conceptualized the study design, prepared the datasets, conducted the analysis, and drafted and revised the manuscript. KB conceptualized the study design, conducted the analysis, and revised the manuscript. RA conceptualized the study design, supervised the data analysis, and revised the manuscript. All authors approved the final manuscript as submitted and agreed to be accountable for all aspects of the work.

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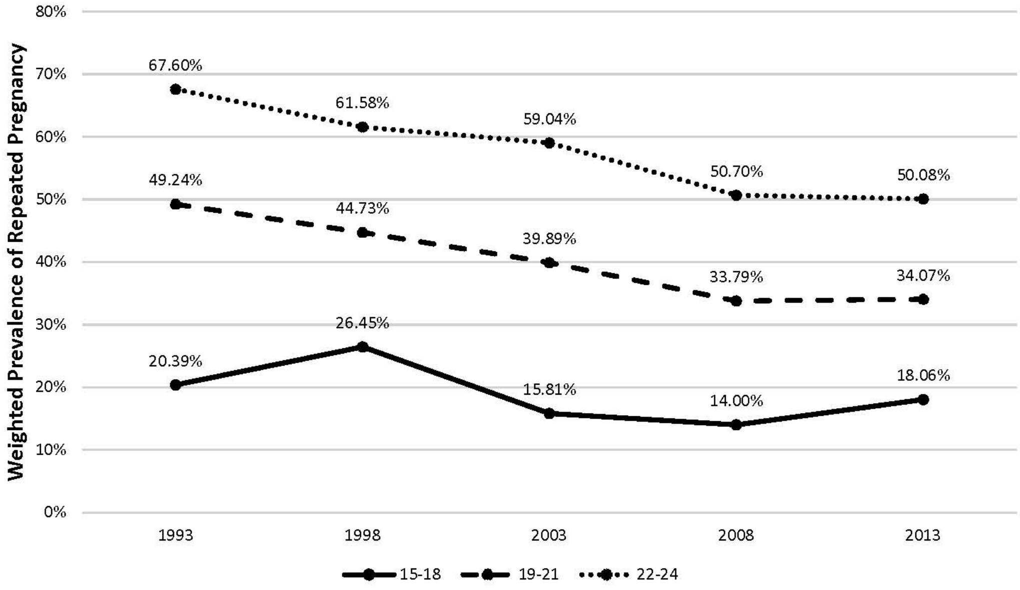
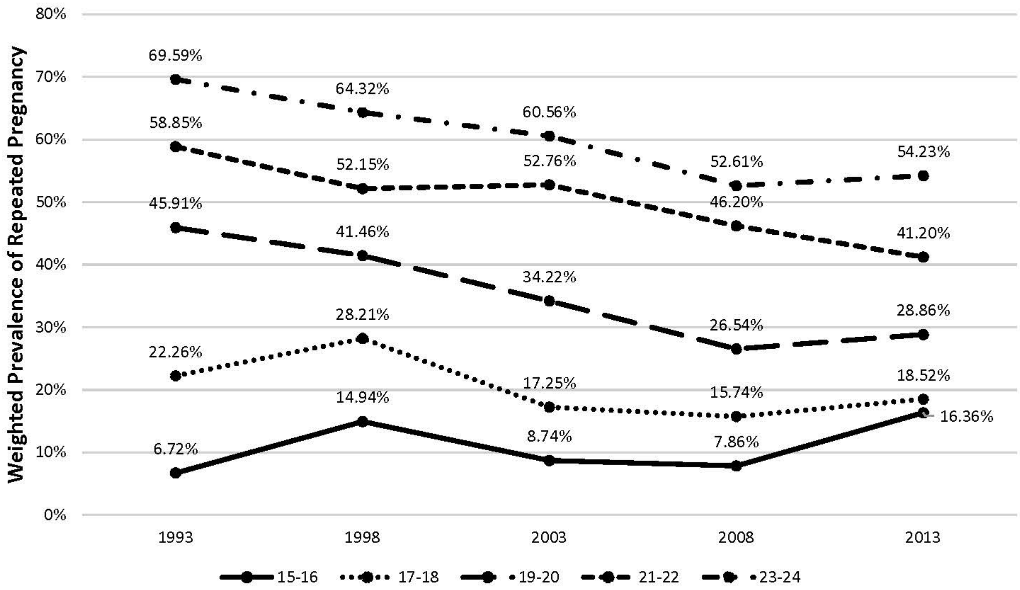


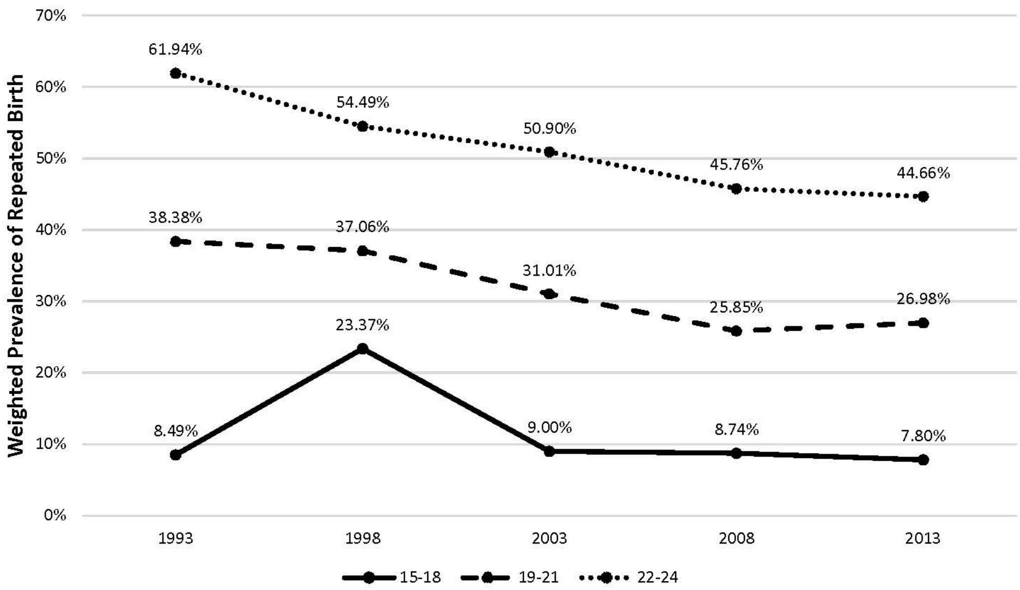
(a) In 3 age groups



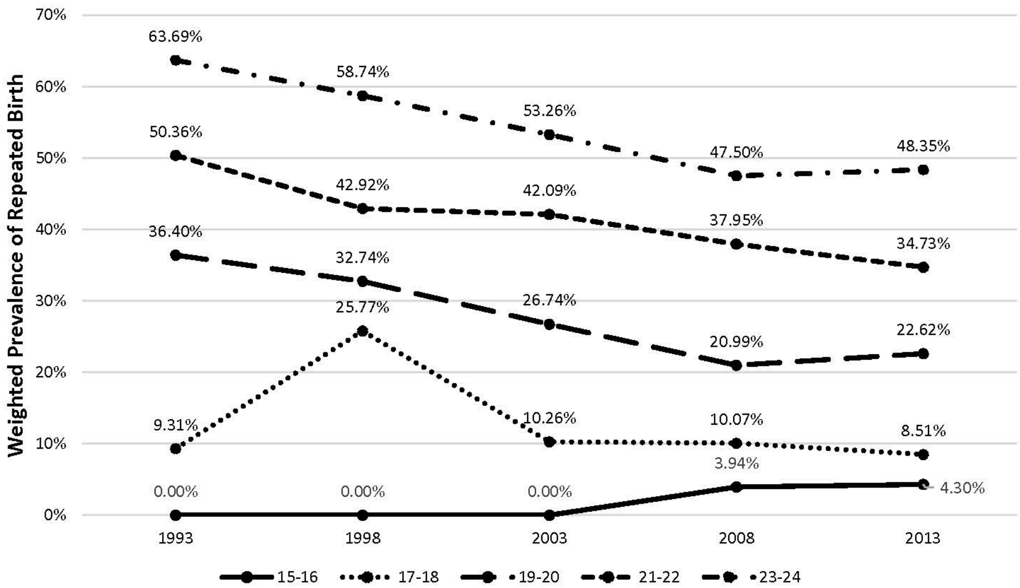
(b) In 5 age groups

Figure 4.1. 1. Prevalence trends of adolescents with repeated pregnancy in the Philippines from 1993 to 2013 by age group

Caption: This figure presents the weighted prevalence of repeated pregnancy using age groups with (a) three and (b) five categories. Groups using the three categories include 15-18 years old, 19-21 years old and 22-24 years old while the five categories including 15-16 years old, 17-18 years old, 19-20 years old, 21-22 years old and 23-24 years old, as represented by each line on the graphs. The x-axis is the survey year arranged in chronological order while the y-axis the weighted prevalence.



(a) In 3 age groups



(b) In 5 age groups

Figure 4.1. 2. Prevalence trends of adolescents with repeated birth in the Philippines from 1993 to 2013 by age group

Caption: This figure presents the weighted prevalence of repeated birth using age groups with (a) three and (b) five categories. Groups using the three categories include 15-18 years old, 19-21 years old and 22-24 years old while the five categories including 15-16 years old, 17-18 years old, 19-20 years old, 21-22 years old and 23-24 years old, as represented by each line on the graphs. The x-axis is the survey year arranged in chronological order while the y-axis the weighted prevalence.

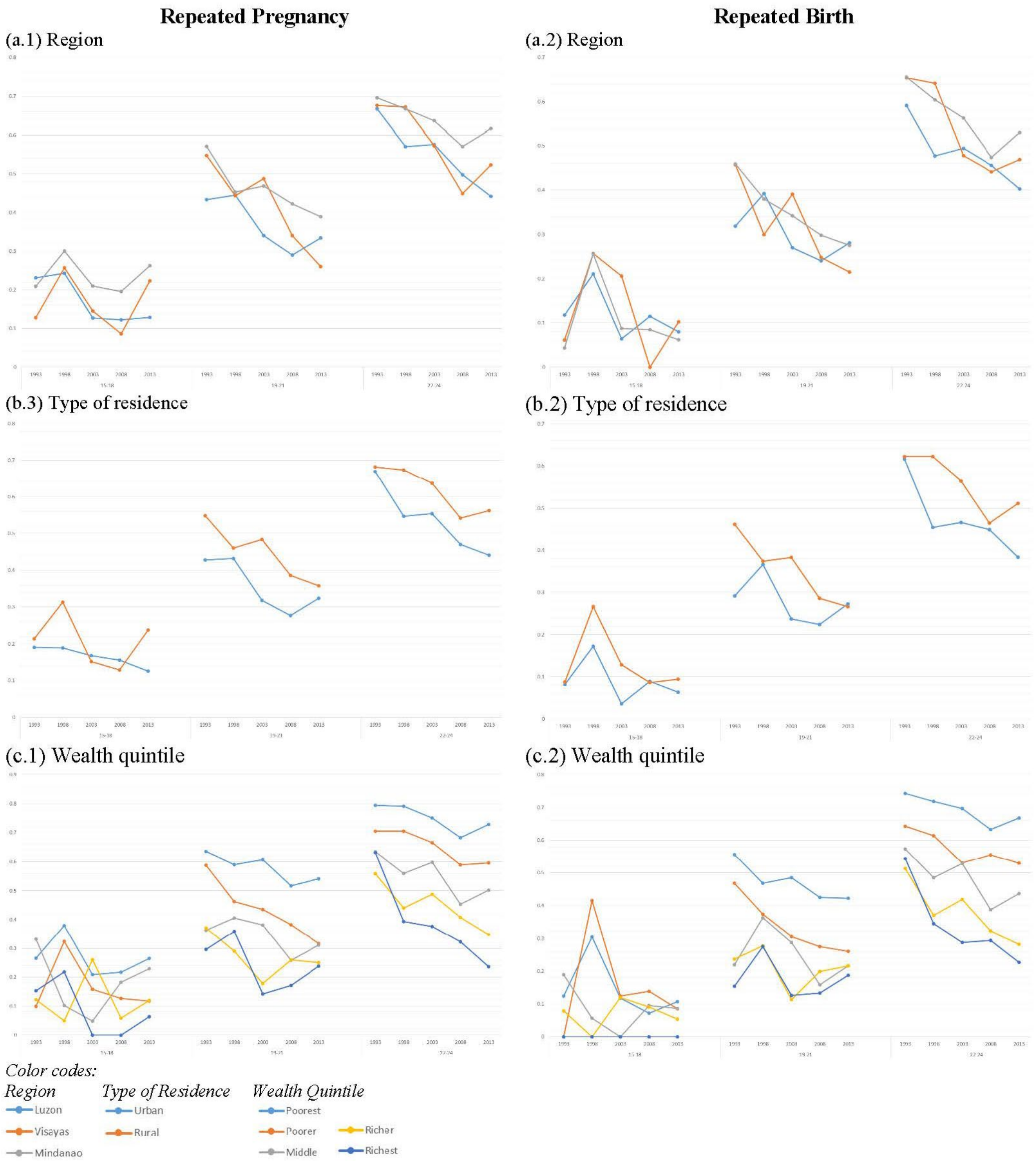


Figure 4.1. 3. Prevalence trend of repeated pregnancies and births among adolescents per socio-geographic variable in each age group

Caption: This figure presents the trend of the weighted prevalence of repeated pregnancies and births in each of the socio-graphic variable using the three age categories: 15-18 years old, 19-21 years old and 22-24 years old. The left column presents the weighted prevalence of repeated pregnancy while the right column presents repeated birth. In each graph, the x-axis is the survey year arranged in chronological order while the y-axis the weighted prevalence. The color of each line represents a category of each socio-geographic variable as shown at the bottom of the graph.

Table 4.1. 1. Prevalence trend of repeated pregnancies and births among adolescents per socio-geographic variable in each age group

Characteristics	1993 n	1993 %	1998 n	1998 %	2003 n	2003 %	2008 n	2008 %	2013 n	2013 %	TOTAL
Age (in 3 groups)											
15-18	107	7.64	124	9.74	128	9.54	165	11.97	213	12.55	**737**
19-21	460	32.86	449	35.27	429	31.97	479	34.74	580	34.18	**2397**
22-24	833	59.50	700	54.99	785	58.49	735	53.30	904	53.27	**3957**
Age (in 5 groups)											
15-16	14	1.00	19	1.49	21	1.56	33	2.39	45	2.65	**132**
17-18	93	6.64	105	8.25	107	7.97	132	9.57	168	9.90	**605**
19-20	268	19.14	268	21.05	269	20.04	300	21.75	352	20.74	**1457**
21-22	429	30.64	387	30.40	385	28.69	402	29.15	502	29.58	**2105**
23-24	596	42.57	494	38.81	560	41.73	512	37.13	630	37.12	**2792**
Region											
Luzon	685	48.93	523	41.08	728	54.25	699	50.69	870	51.27	**3505**
Visayas	275	19.64	244	19.17	187	13.93	229	16.61	232	13.67	**1167**
Mindanao	440	31.43	506	39.75	427	31.82	451	32.70	595	35.06	**2419**
Type of residence											
Urban	604	43.14	481	37.78	672	50.07	554	40.00	761	44.84	**3072**
Rural	796	56.86	792	62.22	670	49.93	825	59.83	936	55.16	**4019**
Wealth quintile											
Poorest	420	30.00	425	33.39	372	27.72	377	27.00	416	24.51	**2010**
Poorer	342	24.43	355	27.89	325	24.22	344	25.00	414	24.40	**1780**
Middle	292	20.86	210	16.50	272	20.27	256	18.56	389	22.92	**1419**
Richer	214	15.00	173	14.00	203	15.00	233	17.00	305	17.97	**1128**
Richest	132	9.43	110	8.64	170	12.67	169	12.26	173	10.19	**754**
With at least 1 birth[a]	1260	90.00	1124	88.30	1181	88.00	1163	84.34	1471	86.68	**6199**
With repeated pregnancy	825	58.93	680	53.42	662	49.33	571	41.41	704	41.48	**3442**
With repeated birth[b]	660	25.04	532	20.18	495	18.78	420	15.93	529	20.07	**2636**
TOTAL[+]	**1400**	**100**	**1273**	**100**	**1342**	**100**	**1379**	**100**	**1697**	**100**	**7091**

Abbreviations: n-Number of respondents

[a] Birth pertains to livebirth; [b] Adolescents with at least 1 pregnancy

Table 4.1. 2. Trend analysis of repeated pregnancy and birth adolescents from 1993-2013 per age group

Year x Age Contrasts	AARR (%)	Unadjusted Model OR	CI	p	Adjusted Model [b] AOR	CI	p
Repeated pregnancy							
Age (in 3 groups)							
15-18	0.57	0.93	0.81-1.07	0.330	0.96	0.82-1.11	0.566
19-21[a]	1.54	0.85	0.80-0.90	<0.001	0.86	0.81-0.92	<0.001
22-24[a]	1.30	0.83	0.79-0.87	<0.001	0.84	0.80-0.88	<0.001
Age (in 5 groups)							
15-16	-7.17	1.24	0.79-1.96	0.351	1.35	0.82-2.23	0.234
17-18	0.84	0.91	0.79-1.06	0.229	0.93	0.80-1.09	0.382
19-20[a]	1.86	0.82	0.76-0.89	<0.001	0.82	0.76-0.90	<0.001
21-22[a]	-1.50	0.84	0.79-0.89	<0.001	0.85	0.80-0.91	<0.001
23-24[a]	-1.10	0.84	0.80-0.89	<0.001	0.85	0.80-0.90	<0.001
Repeated birth							
Age (in 3 groups)							
15-18	0.40	0.87	0.72-1.06	0.181	0.90	0.73-1.10	0.311
19-21[a]	1.49	0.87	0.81-0.93	<0.001	0.88	0.83-0.95	<0.001
22-24[a]	1.39	0.84	0.80-0.88	<0.001	0.85	0.82-0.89	<0.001
Age (in 5 groups)							
15-16	-	2.15	0.54-8.57	0.275	2.47	0.54-11.46	0.245
17-18	0.43	0.87	0.72-1.07	0.186	0.90	0.73-1.11	0.316
19-20[a]	1.89	0.83	0.76-0.89	<0.001	0.85	0.77-0.93	0.001
21-22[a]	1.55	0.86	0.80-0.92	<0.001	0.87	0.82-0.94	<0.001
23-24[a]	1.20	0.85	0.80-0.90	<0.001	0.86	0.81-0.91	<0.001

Abbreviations: AARR-Average annual rate of reduction; OR-Odds ratio; CI-95% Confidence Interval

[a] Significant during Cochran test at 0.001 level; [b] Adjusted for region, type of residence and wealth quintile

Table 4.1. 3. Trend analysis of repeated pregnancy and birth among adolescents per socio-geographic variable in each age group

(Year x Characteristics Contrasts)	Repeated pregnancy									Repeated birth								
	15-18 years old			19-21 years old			22-24 years old			15-18 years old			19-21 years old			22-24 years old		
	OR	CI	p	OR	CI	p	OR	CI	p	OR	CI	p	OR	CI	p	OR	CI	p
Region																		
Luzon	0.82	0.66-1.02	0.08	0.88	0.81-0.96	**0.004**	0.80	0.75-0.86	**<0.001**	0.86	0.65-1.14	0.291	0.92	0.84-1.02	0.118	0.84	0.79-0.90	**<0.001**
Visayas	1.09	0.74-1.61	0.65	0.74	0.64-0.86	**<0.001**	0.84	0.73-0.93	**0.001**	0.94	0.57-1.55	0.801	0.77	0.65-0.91	**0.002**	0.81	0.72-0.91	**<0.001**
Mindanao	1.04	0.82-1.30	0.763	0.85	0.77-0.94	**0.001**	0.91	0.84-0.93	**0.017**	0.86	0.63-1.18	0.358	0.82	0.74-0.91	**<0.001**	0.87	0.80-0.94	**0.001**
Type of residence																		
Urban	0.88	0.69-1.11	0.282	0.88	0.80-0.96	**0.006**	0.80	0.74-0.86	**<0.001**	0.89	0.62-1.27	0.528	0.95	0.85-1.05	0.288	0.81	0.75-0.87	**<0.001**
Rural	0.98	0.82-1.18	0.85	0.83	0.76-0.90	**<0.001**	0.86	0.81-0.92	**<0.001**	0.88	0.69-1.13	0.307	0.81	0.74-0.88	**<0.001**	0.87	0.82-0.93	**<0.011**
Wealth quintile																		
Poorest	0.95	0.75-1.20	0.677	0.9	0.81-1.00	0.056	0.90	0.81-0.99	**0.03**	0.82	0.59-1.14	0.239	0.88	0.79-0.98	**0.018**	0.90	0.82-1.00	**0.041**
Poorer	0.90	0.69-1.19	0.463	0.77	0.69-0.86	**<0.001**	0.87	0.79-0.96	**0.005**	0.97	0.70-1.33	0.833	0.80	0.70-0.91	**0.001**	0.89	0.81-0.98	**0.018**
Middle	0.98	0.71-1.36	0.905	0.92	0.80-1.05	0.202	0.87	0.79-0.95	**0.003**	0.85	0.51-1.44	0.551	0.93	0.79-1.10	0.379	0.87	0.79-0.96	**0.004**
Richer	1.01	0.66-1.53	0.97	0.89	0.75-1.05	0.16	0.82	0.72-0.91	**<0.001**	1.00	0.53-1.88	0.993	0.96	0.79-1.17	0.685	0.79	0.70-0.89	**<0.001**
Richest	0.69	0.27-1.80	0.45	0.89	0.70-1.11	0.298	0.68	0.59-0.79	**<0.001**	NC			0.99	0.76-1.29	0.927	0.73	0.62-0.86	**<0.001**
Adjusted Wald Test	**F**	**p**		**F**	**p**		**F**	**p**		**F**	**p**		**F**	**p**		**F**	**p**	
Region																		
Luzon vs. Visayas	1.57	0.211		3.69	0.054		0.18	0.668		0.09	0.766		3.58	0.059		0.30	0.585	
Luzon vs. Mindanao	2.04	0.154		0.30	0.582		6.01	**0.014**		0.00	0.967		2.56	0.110		0.47	0.493	
Visayas vs. Mindanao	0.06	0.812		2.07	0.151		1.86	0.173		0.08	0.782		0.47	0.491		1.06	0.302	
Type of residence																		
Urban vs. Rural	0.54	0.462		0.94	0.33		2.62	0.106		0.00	0.951		5.21	**0.023**		2.34	0.127	
Wealth quintile																		
Poorest vs. Poorer	0.07	0.787		4.29	**0.039**		0.13	0.718		0.49	0.485		1.22	0.289		0.04	0.844	
Poorest vs. Middle	0.02	0.876		0.03	0.87		0.20	0.656		0.01	0.907		0.31	0.58		0.35	0.55	
Poorest vs. Richer	0.07	0.797		0.03	0.853		1.43	0.232		0.28	0.595		0.60	0.44		2.74	0.098	
Poorest vs. Richest	0.40	0.528		0.02	0.883		9.18	**0.003**		NA			0.65	0.419		5.00	**0.023**	
Poorer vs. Middle	0.15	0.70		3.64	0.057		0.01	0.933		0.16	0.689		1.90	0.169		0.14	0.705	
Poorer vs. Richer	0.18	0.668		1.87	0.172		0.83	0.363		0.01	0.93		2.27	0.133		2.37	0.124	
Poorer vs. Richest	0.28	0.599		1.14	0.285		7.86	**0.005**		NA			1.96	0.162		4.39	**0.036**	
Middle vs. Richer	0.01	0.915		0.09	0.763		0.75	0.387		0.14	0.709		0.06	0.801		1.47	0.226	
Middle vs. Richest	0.45	0.504		0.06	0.807		7.63	**0.006**		NA			0.15	0.70		3.25	0.072	
Richer vs. Richest	0.51	0.475		0.00	0.999		3.78	0.052		NA			0.03	0.866		0.65	0.42	

Abbreviations: OR-Odds ratio; CI-95% Confidence Interval; p-p value; F-F statistic; NC-No cases; NA-Not applicable; OR-Odds ratio

Summary

This study demonstrated the extent of the public health problem from repeated adolescent pregnancy in the Philippines. I found that approximately 20% of women aged 15–18 years continue to experience RP, unlike older age groups which showed a decreasing trend. The problematic pattern can be attributed to the consistent restrictive Philippine legislation, which I found after considering relevant health policies from 1993 to 2013 as seen in the discussion section of *Paper 6.1*. The Philippines’ national policies still prevent female minors (including those who have already had a pregnancy) from accessing family planning services despite available modern contraceptives in the community. This socio-political landscape indicates the need for further investigation by mapping out specific factors at individual, interpersonal, and community levels (discussed in **Chapter 6**). It is also important to determine the health implications of repeated pregnancy to further examine the extent of its burden on adolescent mothers and children (discussed in **Chapter 5**).

Chapter 5: Burden of repeated adolescent pregnancy on maternal and child health

One in every five Filipino adolescent mothers has experienced a repeat pregnancy [153]. This indicates that at least 132,000 adolescent mothers and children in the Philippines are affected by the adverse outcomes of having another pregnancy during teenage years.

Some evidence suggests that the adaptive characteristics of adolescents led to reduced risk for pregnancy complications. Studies have attributed the desensitisation after exposure to paternal antigens [154] and smoother implantation related to modification of maternal arteries during their first pregnancy [155]. However, other strong research has suggested an increased risk of adverse maternal outcomes due to poor physiological recovery of adolescent girls from first pregnancy [22]. Using the Philippine NDHS, I aimed to establish a clearer evidence base on adverse maternal outcomes during a repeat pregnancy. This research is discussed in detail in *Paper 5.1.*

The rapid emotional and socio-economic shifts experienced by adolescent mothers may negatively influence their parenting behaviour [156]. Generally, teenagers acquire skills as they age, however, occurrence of a repeat pregnancy may result in a dual-developmental crisis [66]. Because adolescent mothers lack the skills required to parent at least two children, they may exercise poor feeding practices, causing their subsequent children to have poor nutrition. I used the Cebu Longitudinal Health and Nutrition Survey to investigate the association of repeated pregnancy with child stunting, which is acknowledged as a strong indicator of child nutrition and development [157]. This epidemiological analysis is described in *Paper 5.2*.

5.1 Adverse maternal outcomes

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Title:

Increased risk of maternal complications from repeat pregnancy among adolescent women

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Synopsis: A repeat pregnancy, either closely or adequately spaced, increased the likelihood of maternal complications by at least fourfold among adolescent mothers.

Abstract

Objective: To evaluate the risk of adverse maternal outcomes among adolescents experiencing a repeat pregnancy in the Philippines.

Methods: Data were analysed from four waves (1998–2013) of a cross-sectional nationally representative survey. We included non-nulliparous and non-pregnant women aged 15–44 years with an inter-pregnancy interval (IPI) of 24 months of less were included. Multivariate logistic regression was used to measure the association of repeat pregnancy with adverse maternal outcomes by age group (11–19, 20–24, and 25–45 years), accounting for clustering within each respondent. A stratified analysis by IPI (≤24 vs >24 months) was conducted among 11–19-year olds.

Results: No association was observed between repeat pregnancy and low birthweight among adolescent mothers. A second pregnancy increased the risk of pregnancy (adjusted odds ratio [OR], 10.49; 95% confidence interval [CI], 4.00–27.49) and labour (adjusted OR, 3.61; 95% CI, 1.61–8.09) complications among teenage women (11–19 years). Interaction tests showed there was a significant increase in these risks as compared with older women. Stratified analysis by IPI did not modify the observed effect for either outcomes.

Conclusion: Repeat pregnancy among Filipino adolescents increased the risk of pregnancy and labour complications irrespective of IPI.

Introduction

Complications during pregnancy are one of the leading causes of mortality among females aged 15–19 years [1]. They are also considered to be the third leading cause of disability among teenagers [2], especially in low-resource countries such as the Philippines, which has the highest reported adolescent fertility rate in the west Pacific [3]. In addition to negative maternal outcomes, young mothers are also at risk of delivering newborns with low birthweight and severe neonatal complications [4].

Despite the negative health consequences of an early pregnancy for both young women and their newborns, 37%–64% of adolescent mothers will conceive again within 24 months of delivery, with the highest incidence peaking at 18 months [5]. In the Philippines, one in every five non-primigravid adolescent girls will have another pregnancy before the age of 19 years [6]. Among young women, second pregnancies may result in greater socio-economic burden and serious complications owing to physiologic and psychosocial immaturity [7, 8]. The risks of pregnancy-induced hypertension, severe anaemia, and death due to pregnancy-related causes are also increased during subsequent pregnancies, especially if the inter-pregnancy interval (IPI) is shorter [9]. Neonatal mortality and low birthweight are also more likely to occur among multiparous adolescent mothers as compared with first-time adolescent mothers [10].

Our understanding of the impact of repeat pregnancy on adolescent reproductive health is still developing. Whereas the effect of young age on poor maternal outcomes has been widely explored, evidence on adolescents' repeat (or second) pregnancy is scarce, particularly in low- and middle-income countries [9, 11]. Recent research has yielded inconsistent findings, and the influence of multi-parity among adolescents remains to be established. Some studies have suggested a direct association between repeat pregnancy and maternal haemorrhage [12], preterm delivery [13], and low birthweight [10], while a global study on adolescent maternal health reported a parity-adjusted risk of infection and pregnancy-induced hypertension [4]. Conversely, other studies did not find a risk of pregnancy-related complications [5] or an association with low birthweight [7-9] for repeat pregnancies among adolescents.

Such inconsistencies may be due to methodologic issues affecting cross-sectional and longitudinal studies differently. It has been argued that cross-sectional studies often produce overestimates due to the inclusion of higher birth orders (i.e., ≥3), whereas results from longitudinal studies can underestimate the true effects owing to selection bias [9]. This is particularly true for longitudinal studies in which the data are obtained from hospital delivery records.

There are also limitations related to the analytical approach. Rather than comparing mothers with one pregnancy versus mothers with two pregnancies, it would be better to compare first and second pregnancies by the same mother. For example, a population-based study comparing second births among teenagers with second births among young adults did not take into account either the biologic maturity of adolescents or the IPI [13]. Another study based on data from the same mothers did not adjust for clustering among the repeat pregnancies [7]. Mothers who are in their second or later pregnancies have different social and obstetric characteristics as compared with first-time mothers, which can lead to biased estimates. Lastly, adolescent mothers experiencing a repeat pregnancy usually have a low socio-economic status, which is also a strong determining factor for a range of outcomes including maternal complications [8].

The primary aim of the present study was to address some of these methodologic shortcomings in investigating the risk of adverse maternal outcomes of a second versus a first pregnancy among adolescent mothers. Secondary aims were to measure differences in risk between adolescents and young adults and between adolescents and older women, and to evaluate the role of IPI in adverse maternal outcomes (including complications during pregnancy and childbirth, and low birthweight) among adolescents.

Methods

The present study analysed data from the 1998, 2003, 2008, and 2013 Philippine National Demographic Health Survey (NDHS). The study was approved by the University of Queensland, School of Public Health Ethics Committee, Herston, Queensland, Australia, on April 11, 2016. The NDHS enumerators obtained informed consent from participating women at the start of their interviews.

The Philippine NDHS is a routine cross-sectional survey conducted every 5 years under the partnership of the Philippine Statistics Authority with ICF International to collect current and retrospective information on maternal and child health. The respondents across all survey years were selected by multi-stage sampling stratified by region and type of residence. The first stage involved selection of households using cluster and systematic sampling; the second stage surveyed all women from the selected households. In total, 52 266 households participated in the 1998 to 2013 surveys with a 98% response rate.

For this study, non-nulliparous and non-pregnant women aged 15–44 years were identified from the survey sample, including those aged 15–24 years who had two singleton deliveries with an IPI of 24 months or less during the adolescent period (11–19 years), and those aged 20–45 years who had two singleton deliveries after the age of 20 years occurring during the same age period (i.e. 20–24, 25–29, 30–34, 35–39, and 40–44 years).

The prevalence of pregnancy and labour complications and low birthweight during the first and repeat pregnancy was determined per age group (11–19, 20–24, and 25–44 years). Repeat pregnancy was defined as a second birth experience with a maximum IPI of 24 months from the first birth experience. Pregnancy complications included the following self-reported complications: vaginal bleeding; headache; dizziness; swollen face, hands, or feet; and anaemia. Labour complications, namely the occurrence of any complications at the time of delivery, included prolonged labor, excessive bleeding, sepsis, and loss of consciousness. Low birthweight was defined as 2500 g or less at birth (either reported by the respondent or validated through delivery records). All measures were dichotomized as the presence or absence of the outcome.

All statistical tests were performed by Stata version 14 (StataCorp, College Station, TX, USA). To measure the association between repeat pregnancy and each outcome variable, logistic regression analysis was done by age group while accounting for clustering within each respondent. A woman's repeat pregnancy was considered as exposure and her first pregnancy as non-exposure [5]. Estimates were compared among age groups by using interaction tests. All models were adjusted for survey year, demographic characteristics, socio-economic status, timing and number of prenatal visits, type of birth attendant, and place of delivery.

A second analysis included women aged 15–24 years with an IPI of more than 24 months to evaluate variations in the risk of adverse maternal outcomes while giving birth during adolescence. The analysis was stratified by IPI (i.e., ≤24 and >24 months) and interaction tests were used to establish differences between effect estimates. In all analyses, a P-value of less than 0.05 was considered statistically significant.

Results

The NDHS surveys included 2518 non-nulliparous and non-pregnant women aged 15–44 years with an IPI of 24 months or less. Overall, 466 women had two singleton deliveries with an IPI of 24 months or less during adolescence (11–19 years), 860 who had deliveries during young adulthood (20–24 years), and 1192 who had deliveries in latter ages (25-44 years). This equated to a total of 932 delivery records for women aged 11–19 years, 1720 for those aged 20–24 years and 2834 for those aged 25–44 years.

The whole sample (aged 11–44 years; n=2518) was equally represented across all survey years and residence types. Nearly half (45.40%; n=1142) of the respondents were classified as coming from low-income households. Approximately 80% (n=1990) of the respondents had completed secondary education. More than half of the sample underwent delivery in a health facility attended by a trained birth attendant who was a midwife, nurse, or physician.

Approximately 60% of 11–19-year-old respondents came from low-income (n=298) and rural (n=272) households. Approximately 60% (n=268) were married, and 32% (n=172) were not married but living with their partner. As compared with older age groups, a higher incidence of 11–19-year-olds delivered at home (70.6%; n=275), and were helped by traditional birth attendants (57.5%; n=218). A higher incidence of adverse maternal outcomes was observed among women who did not complete secondary education and those from low-income households. A higher percentage of adverse maternal outcomes was also observed among those who reported at least four prenatal visits starting in the first trimester, and those who had facility-based deliveries and were attended by skilled birth attendants (see Table 5.1. 1).

Across all age groups, the prevalence of pregnancy and labour complications over the 20 years covered by the survey were generally elevated during a repeat pregnancy (see Figure 5.1. 1). A greater difference in the prevalence of pregnancy complications between the repeat and first pregnancy was observed among adolescents (difference, 31.8%; P<0.001) as compared with those aged 20–24 years (difference, 31.0%; P<0.001) and those aged 25-45 years (difference, 29.5%; P<0.001). Delivering a low-birthweight neonate after a repeat pregnancy was elevated only among women aged 11–19 years. However, women from older age groups showed a higher prevalence of low-birthweight neonates for their first pregnancy than for their repeat pregnancy.

There was a higher likelihood of pregnancy complications during the repeat pregnancy for 11–19-year-olds (adjusted odds ratio [OR], 10.49; 95% confidence interval [CI], 4.00–27.49). Adolescents were nearly four times more likely to experience prolonged labour, excessive bleeding, sepsis, and/or loss of consciousness during labour for a repeat pregnancy (adjusted OR, 3.61; 95% CI, 1.61–8.09). Conversely, the risk of low birthweight did not change between the first and repeat pregnancy among adolescents.

Figure 5.1. 2 shows the risk estimates expressed as ORs for each adverse maternal outcome during repeat pregnancy by age group. Despite the higher prevalence of complications during repeat pregnancy across all age groups, the risk of pregnancy and labour complications during repeat pregnancy increased with decreasing age. An interaction test showed that the risk of pregnancy complications among 11–19-year-olds was higher than it was among 25–45-year-olds (β =0.96, P=0.022). Despite a null interaction test between adolescents and young adults (β =0.72,

P=0.085), the OR of pregnancy complications for 11–19-year-olds was more than 3 units higher than that for 20–24-year-olds.

There was no difference in pregnancy complications by IPI among 11–19-year-olds (see Table 5.1. 2). Women aged 11–19 years were still ten times more likely to have pregnancy complications in the second pregnancy whether they had an IPI of 24 months or less or an IPI of more than 24 months. By contrast, adolescent mothers with an IPI of 24 months or less were more likely to have labour complications than those with an IPI of more than 24 months (β =1.22, P=0.044).

Discussion

The study investigated the risk of adverse maternal outcomes after a repeat pregnancy among Filipino women of different ages, with particular attention to those experienced by adolescent mothers. There were no apparent differences in the risk of poor maternal outcomes between an IPI of less than 24 months and an IPI of more than 24 months, and no association between repeat pregnancy and neonatal birthweight. The study found, however, that a repeat pregnancy led to a 10-fold increased likelihood of pregnancy complications and a 3-fold increased likelihood of labour complications among women aged 11–19 years as compared with older women. This suggests that individualized clinical solutions should be formulated for adolescent mothers to reduce the increased risk of complications following a repeat pregnancy.

To our knowledge, the study is the first to evaluate the impact of a second pregnancy on adolescent maternal health in a low-resource country, and to clarify inconsistencies in the existing evidence by addressing bias and using population-based data. Possible sources of bias were using a robust approach to account for confounding related to socio-economic [8] and biologic differences when comparing mothers with and without repeat pregnancy. Instead of comparing mothers with and without repeat pregnancy, the first and repeat pregnancy experiences of the same mothers were compared, and then the estimate obtained was adjusted for clustering within the same respondent and socio-economic status. In addition, recall bias was minimized by limiting the data to women who had their repeat pregnancy within 10 years of the survey.

A study by Klerman [9] argued that there is a risk of overestimating the effect of repeat pregnancy in many cross-sectional analyses by including higher-birth orders. This was addressed by including only mothers with two birth experiences at the time of the survey. Being based on large-scale community-based surveys, the present study is also more representative than others of the general population of young pregnant women [4].

The present findings are consistent with previous cross-sectional and longitudinal US-based studies, which also reported a null association between parity and low birthweight [7-9]. By contrast, an increased risk of maternal and neonatal mortality during subsequent pregnancy experiences of teenage mothers aged 13–18 years was found in a prospective study in rural Germany [10]. Studies from low-resource countries have also reported similar results among socially disadvantaged adolescents as compared with young adults. For example, data from 18 countries in Latin America showed an increased risk of adverse maternal obstetric outcomes, including haemorrhage and anaemia, among women of 19 year or younger as compared with older women [12]. Another analysis covering 29 countries from Asia, Africa, and America found that maternal age younger than 20 years was linked to a higher risk of hypertensive disorders and systemic infection as compared with a maternal age of 20–24 years [4]. However, those two multi-country studies did not determine the effect of parity on maternal outcomes by age group and only adjusted for it.

A retrospective cohort in a Turkish hospital has reported contradictory results [5]. By analysing birth outcomes of the same mother, the study found an association between (second) birth order and gestational complications. However, the study had a small sample size and excluded adolescents who delivered at home, which is the typical scenario in most low-resource countries [14].

A previous study that found a lower risk of maternal complications during subsequent pregnancies attributed this association to desensitization after exposure to paternal antigens and to smoother implantation related to modification of maternal arteries during the first pregnancy [15]. Aside from the difficulty in measuring these physiologic adaptations, this assumed adaptive process might be affected by recurring physiologic and environmental factors [16]: physiological needs and adverse social factors are likely to increase maternal complications among pregnant adolescent girls. The ongoing growth and development of adolescents means that nutritional requirements increase exponentially during a first pregnancy [17]. On conceiving a second pregnancy, physiologic and psychosocial recovery from the first pregnancy can become disrupted [18]. This may lead to adverse outcomes, including complications and spontaneous abortion [19]. In addition, pregnancies that occur during teenage years are likely to delay completion of secondary education, reduce employment opportunities, and increase the risk of prolonged poverty and social disadvantage [20]. A low-income setting also predisposes prospective adolescent mothers to a poor diet, resulting in inadequate weight gain and suboptimal nutrient intake [7]. These disrupted recovery processes among teenagers might also explain the present null findings related to IPI during the adolescent period, which contrasts with the well-established positive association between short IPI and perinatal complications among older women.

Improving access to maternal care services can help prevent the occurrence of adverse conditions during repeat pregnancy. However, the present study found a higher incidence of pregnancy and labour complications among those who had adequate prenatal care and a facility-based delivery as compared with those who had poor access to maternal services. An analysis of linked data in the United States found similar results, whereby increasing numbers of prenatal visits increased the odds of preterm delivery [7]. This may be a sign of pre-existing adverse conditions that solicit a higher number of visits to health and maternity facilities.

The adverse effect of poor maternal care is commonly observed among adolescents in low-resource countries who often avoid seeking care from trained birth attendants [21]. Studies from low- and middle-income countries have shown that adolescents who experience a repeat pregnancy are less likely to access maternal services owing to socio-cultural factors and negative perceptions about the quality of care in health facilities [22]. Strategies to promote facility visits and access to skilled prenatal care such as adolescent-friendly services would be beneficial to minimize the risk of complications during pregnancy and delivery [11].

The present study has some limitations. First, despite using four datasets from a large-scale survey, there were fewer than 100 adverse incidents from the pooled delivery records of adolescents, resulting in reduced statistical power. Studies from low-resource countries with larger samples are needed to confirm the findings. The analysis excluded 800 women who had two pregnancies in different time periods (i.e., the first pregnancy during adolescence, and the second pregnancy during young adulthood), which also reduced the sample size.

Second, all outcome measures were self-reported, which might have resulted in recall bias. However, NDHS questionnaires enabled the respondents to clearly describe outcomes by repeating questions and probing for at least six possible types of complication. There is also evidence to suggest that self-report measures are reliable to identify the presence of maternal morbidities [23]. Self-report measures have also been found to be accurate in reporting health service utilization (i.e., prenatal care, facility-based delivery, and birth attendants) [24] and pregnancy experience among adolescent girls [19].

Third, as in all cross-sectional studies, it was not possible to establish causality between repeat pregnancy and outcomes. Fourth, socio-economic status was reported at the time of the survey and did not necessarily reflect the income class of the respondents during their first and repeat pregnancy. Last, there were no measures of nutritional status, which might be an important confounder or mediator in the association between repeat pregnancy and obstetric/pregnancy outcomes, or mental health status, which might also be associated with poor birth outcomes [25]. Future studies with the capacity to account for such factors are needed.

In conclusion, repeat pregnancy among adolescents increased the likelihood of pregnancy and labour complications regardless of IPI. The risk of maternal complications was found to be higher among adolescents than among young and older adults. Additional analyses using national surveys and/or community-based cohorts from other countries are needed to clarify the present findings and strengthen their generalizability to other countries.

Authors' Contributions: Mr. Maravilla conceptualized the study design, prepared the datasets, conducted the analysis, and drafted and revised the manuscript. Dr Betts conceptualized the study design, conducted the analysis, and revised the manuscript. Prof Alati conceptualized the study design, supervised the data analysis and revised the manuscript. All authors approved the final manuscript as submitted and agreed to be accountable for all aspects of the work.

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Table 5.1. 1. Sample characteristics and occurrence of pregnancy complications, labour complications and low birthweight infants in each covariate by age group

Characteristics	Sample			Pregnancy complications			Labour complications			Low birthweight		
	11-19 y/o	20-24 y/o	25-44 y/o	11-19 y/o	20-24 y/o	25-44 y/o	11-19 y/o	20-24 y/o	25-44 y/o	11-19 y/o	20-24 y/o	25-44 y/o
Age during term	466	860	1192	18.26 (1.01)	22.45 (1.03)	29.18 (2.81)	17.64 (1.09)	22.40 (1.15)	28.87 (2.93)	17.73 (1.15)	21.92 (1.07)	29.28 (3.31)
Survey year												
1998	126	256	338	12.70	23.37	28.13	19.20	17.75	21.88	23.64	14.79	17.06
2003	120	240	306	15.00	20.26	20.42	5.83	7.52	5.83	23.21	21.05	18.52
2008	100	198	282	18.00	18.44	20.20	6.00	12.06	7.58	15.25	21.31	19.20
2013	120	166	266	30.00	24.81	19.28	8.33	11.28	11.45	24.97	17.06	24.10
Region												
Luzon	208	486	586	25.00	22.87	23.05	11.06	12.63	12.14	19.17	17.93	16.94
Visayas	78	142	212	15.38	16.51	14.08	8.97	13.68	9.15	32.00	24.60	28.57
Mindanao	180	232	394	13.33	22.84	26.29	9.50	11.17	13.79	20.78	16.59	17.57
Type of Residence												
Rural	272	394	646	13.60	20.28	21.07	9.23	13.62	15.23	16.95	20.18	17.49
Urban	194	466	546	26.29	23.44	26.61	11.34	10.81	9.44	27.13	17.33	20.19
Income class												
Poor	298	270	574	15.10	19.34	18.89	11.11	12.02	15.56	21.88	18.12	20.47
Middle	66	188	242	28.79	23.14	24.47	4.55	13.64	10.64	27.27	16.25	26.72
Rich	102	402	376	23.53	24.47	23.88	10.78	11.97	10.45	20.00	20.75	14.89
Highest educational attainment												
No education or primary	176	116	236	16.48	15.68	12.93	12.00	16.53	14.66	20.63	19.10	22.50
High school or higher	290	744	956	20.34	23.22	23.92	8.97	11.30	11.69	22.83	18.62	18.80
Marital status												
Residing with partner, not married	172	116	240	22.09	25.42	16.38	8.72	15.00	13.79	24.07	21.71	16.28
Not residing with partner, not married	26	28	36	26.92	33.33	21.43	15.38	11.11	7.14	21.43	23.81	42.11
Married	268	716	916	16.04	20.31	23.46	10.49	11.68	12.01	20.80	17.44	18.62
Antenatal visits												
<4 visits or ≥4 visits but didn't start 1st trimester	377	601	898	12.73	13.92	11.48	8.51	8.91	9.32	20.67	19.62	20.13
≥4 visits, started 1st trimester	89	259	294	44.94	45.58	47.88	16.85	22.79	18.53	26.47	16.81	17.62
Place of delivery												
Home	275	280	531	18.91	25.80	27.50	11.27	14.69	12.50	22.50	13.22	18.93
Health facility	135	386	447	26.67	27.29	30.05	11.85	15.44	17.62	22.05	22.22	19.19
Skilled-birth attendance												
No	218	205	413	15.60	24.94	26.83	12.84	13.56	14.63	20.51	15.58	18.58
Yes	192	462	568	28.13	27.46	29.87	9.90	16.02	13.02	23.08	19.88	19.88

Table 5.1. 2. Risk of adverse maternal outcomes during a repeat pregnancy in 11-19 year old women stratified by inter-pregnancy interval

Outcome measures	Overall		IPI (≤24 months) n=466		IPI (>24 months) n=212		Interaction p-value (RPxIPI)
	AOR	95%CI	AOR	95%CI	AOR	95%CI	
Pregnancy Complications	10.33	4.80-22.21	10.49	4.00-27.49	10.93	2.21-54.04	0.345
Labor Complications	3.39	1.65-6.96	3.61	1.61-8.09	3.20	0.66-15.44	0.044
Low Birthweight	1.00	0.46-2.19	0.98	0.41-2.36	0.82	0.09-7.86	0.703

Notes: Overall includes adolescents who has an IPI ≤24 months and >24 months. Adjusted for survey year, demographic characteristics, socio-economic status, timing and number of antenatal visits, type of birth attendants, and place of delivery
Legend: AOR- Adjusted Odds Ratio; 95%CI-95% Confidence Interval; IPI-Inter-pregnancy Interval; RPxIPI-Interaction term

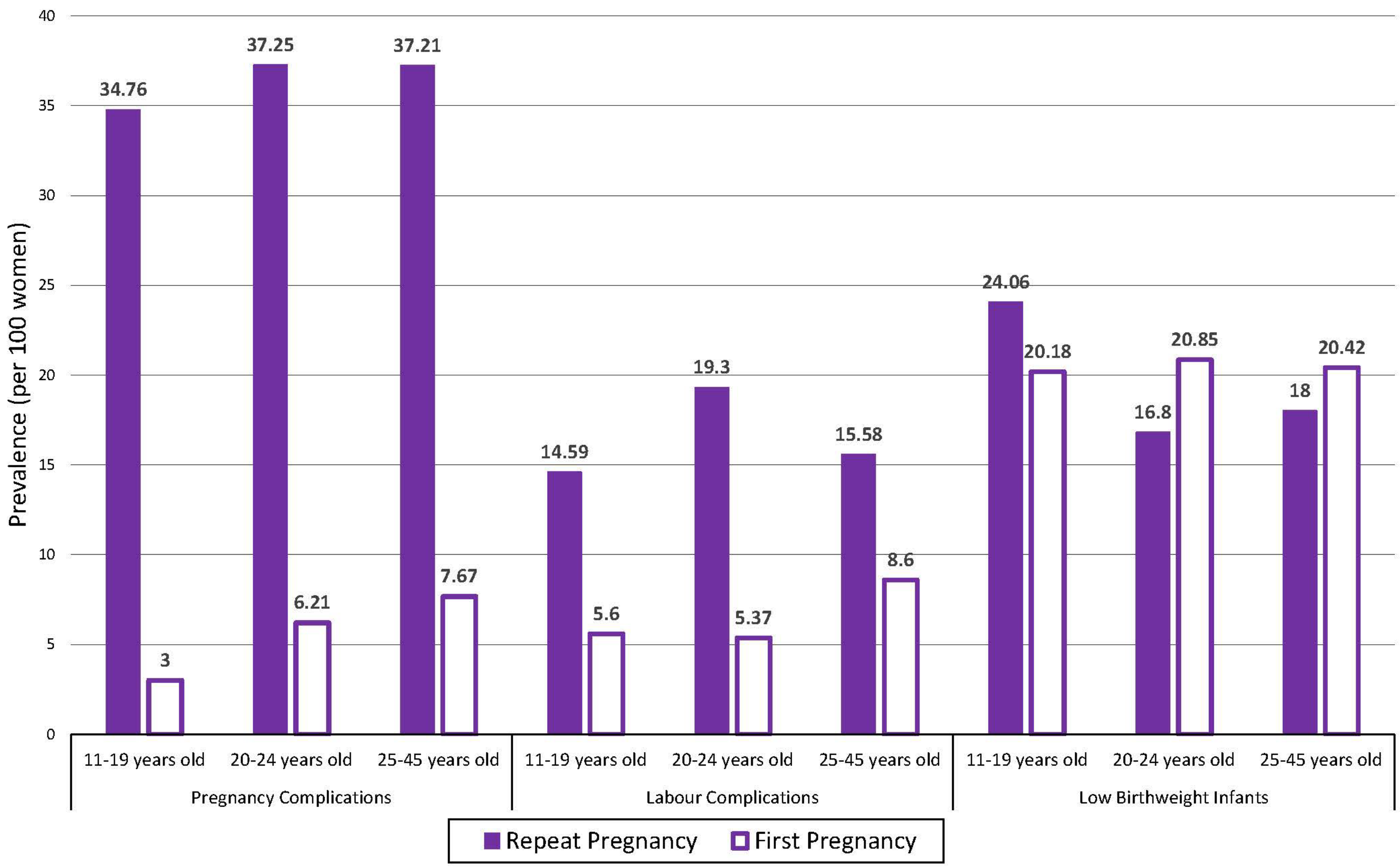
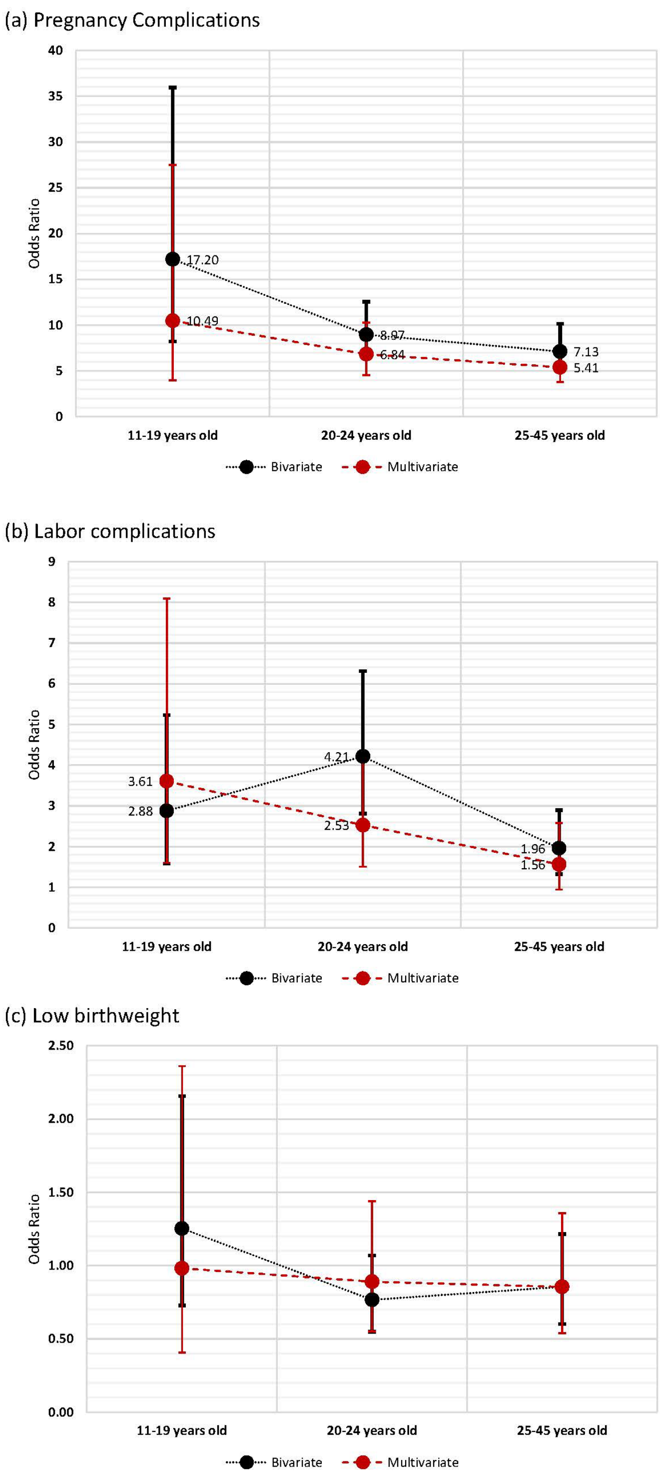


Figure 5.1. 1. Prevalence of pregnancy complications, labour complications and low birthweight during a repeat pregnancy by age group



Notes: The dot represents the odds ratio while the lines from each dots represent the 95% confidence interval. Multivariate estimates are adjusted for survey year, demographic characteristics, socio-economic status, timing and number of antenatal visits, type of birth attendants, and place of delivery

Figure 5.1. 2. Adverse maternal outcomes during a repeat pregnancy by age group

5.2 Child stunting

Manuscript and formal citation

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Title:

Offspring stunting from repeated pregnancy among young mothers in the Philippines

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Abstract

Objectives. Repeated pregnancy leaves young mothers nutritionally deprived which may in turn lead to poor infant growth. We measure the occurrence and persistence of stunting among subsequent offspring of adolescent and young mothers who experienced repeated pregnancy.

Methods. We used data from the Cebu Longitudinal Health and Nutrition Survey. We selected mothers aged ≤24 years (n=1033) with singleton birth. Offspring's length-for-age z scores (LAZ) at 12 and 24 months were determined using the WHO growth standard. We fitted stunting occurrence (i.e. LAZ<-2) and persistence from 12 to 24 months into regression models and tested for the mediating effect of low birthweight and feeding practice.

Results. We found an association between repeated pregnancy and stunting at 12 and 24 months (AOR=1.40; 95%CI=1.18–1.66 and AOR=1.25; 95%CI=1.04–1.50 respectively) as well as persistent stunted growth up to 24 months (adjusted RRR=1.51; 95%CI=1.21–1.88). Offspring of mothers aged ≤24 years old who experienced repeated pregnancy also had lower LAZ with an adjusted mean difference of -0.16 (95%CI=-0.24–-0.09). The proportion of the total effect mediated was <11% via low birthweight and <25% via feeding practice for stunting at 12 and 24 months. The total effect of repeated pregnancy via low birthweight and feeding practices on persistence was β=0.26 (95%CI=0.10–0.40).

Conclusion. Repeated pregnancies among adolescent and young mothers lead to increased risk of occurrence and persistence of stunting in offspring aged 12–24 months.

Key Messages

- Repeated pregnancy in young mothers is a predictor of offspring stunting.
- Subsequent offspring of young mothers aged 15-24 years are at risk of stunting by at least 40% from 12 to 24 months of age
- Poor feeding practice and low birthweight mediated the effects of repeated pregnancy on infant growth trajectories which highlights the importance of mitigating low birthweight and improving feeding practices.

Introduction

Globally, stunting affects more than 100 million children under five,[1] and is associated with poor cognition, reduced school performance, immunodeficiency, and child mortality.[2] In addition to adverse health outcomes, stunted children tend to have poorer economic productivity and lower wages in adulthood.[3] These negative impacts make stunting, especially in the first 1000 days of life, a profound indicator of poor wellbeing, social inequality, and disadvantage.

The pathogenesis of stunting originates in the first 1000 days of life, extending from early fetal development until 24 months after birth. Inadequate maternal nutrition and poor antenatal care can directly and indirectly result in an unhealthy intrauterine environment and poor fetal growth.[4] Immediately following birth, suboptimal infant feeding practices slow offspring's growth rate.[4] For example, improper (i.e. late, inadequate and inappropriate) complementary feeding negatively affects the child of nutrition due to the rapid increase in nutritional needs of infants after six months of age. Diarrheal infections and hygiene practices related to poor socio-economic status (SES) can also lead to stunting due to nutrient malabsorption and high intestinal permeability.[5]

Early pregnancies are known to play an important role in stunting, due the competing demands for pubertal development and growth of the fetus during the pregnancy.[6 7] This leads to greater nutrition partitioning, which compromises the growth and development of the mother and the fetus.[6 7] A subsequent pregnancy further aggravates this mechanism through continuous depletion of adolescents' nutritional stores, often resulting in preterm births, maternal complications, and low birthweight, which are in turn strong risk factors for offspring stunting.[1 8]

Although current research indicates the impact of repeated pregnancy among young mothers on child stunting, there is a lack of evidence in support of this inferred relationship. An analysis of prospective cohorts in developing countries showed lower length-for-age *z* scores (LAZ) at 24 months among offspring of 15- to 19-year-old mothers compared to older age groups.[9] Furthermore, an unadjusted correlation was observed between LAZ and a parity of 2 or more. On the other hand, a cross-sectional study revealed null associations between stunting and parity but showed differences in stunting from 6 to 24 months in infants.[10] Inconsistent findings from recent studies imply the need to explore the impact of parity on stunting trajectories during the critical period of 12–24 months. Trajectories indicating either persistence or recovery, especially during the peak age for stunting, may provide important information about long-term offspring outcomes.

We sought to explore the growth trajectories of the subsequent offspring of young mothers in the Philippines. As a developing country, the Philippines is an ideal site to explore this research question for two main reasons. Firstly, the Philippines has a high rate of fertility in young women compared to other low- and middle-income countries.[11] Secondly, one third of pregnant Filipino adolescents are undernourished,[12] which predisposes a high number of their offspring to poor nutrition.

In this study, we aim to measure the magnitude of the association between repeated pregnancy in adolescent and young mothers and offspring stunting at 12 and 24 months, and its persistence from 12 up to 24 months. Our study also explores the potential mediating effect of low birthweight and feeding practices to better investigate the relationship between repeated pregnancy and stunting. We define the women of interest in this study – those aged <20 and 20–24 years old – as ‘young mothers' as per the World Health Organization's (WHO's) definition.[13]

Methods

Sample and Population

We used the Cebu Longitudinal Health and Nutrition Survey conducted in Cebu City, Philippines.[14] It is a three-generation community-based cohort, composed of urban households from peri-urban and rural communities. Using the Philippine's 1980 census as the sampling frame, a single-stage cluster sampling technique was employed to randomly select *barangays*. This survey recruited pregnant women in the sample households, totaling 3327 mothers aged 14–47 years old with singleton livebirths.

In this study, we used the 1983–1986 data of the Cebu cohort which consist of the baseline and bimonthly follow-up information of women surveyed. While this dataset describes young mothers 35 years ago, results from this study are still relevant in the Philippines and other developing countries due to consistent trends of adolescent fertility and repeated adolescent pregnancy as well as patterns of poor infant feeding habit among young mothers across years.[11 15 16] Baseline data, which include pregnancy history, household demographics, and socio-economic status were collected during the second to third trimester of pregnancy, followed by an immediate postpartum interview using a validated questionnaire.[14] Afterwards, bimonthly data collection for 24 months was conducted to follow the health and nutritional status of the mother and the index child. In the case of this study, we only used the data collected at 12 and 24 months. Infant anthropometric data were measured using calibrated equipment. Data collectors were trained and assessed for proficiency using the Habicht procedure.[17] We used data from 1284 eligible women aged <25 years and their offspring with a retention rate of 88% at 24 month follow-up.

Measures

We used the WHO's growth standard to derive the length-for-age *z*-score (LAZ) of the index child. Using this score, we defined stunting as LAZ<-2 at 12 and 24 months. We also created a measure of persistence of stunting from 12 to 24 months. Index children who were stunted at both 12 and 24 months were classified as "persistent"; those stunted at 12 months but not at 24 months were classified as "recovered"; those stunted only at 24 months were classified as "late incident"; and those who did not experience stunting were classified as "normal".

We used the number of past pregnancies in reference to the index child to measure repeated pregnancy. We also measured inter-pregnancy interval (IPI) as the interval between the index child and the most recent pregnancy termination or livebirth before the index child. We dichotomized IPI into ≤24 months and >24 months; we included first-time pregnant women (i.e. those with no history of pregnancy) in the latter group.

We used four binary (yes/no) feeding practice predictors as follows: initiation of breastfeeding within 24 hours after delivery, exclusive breastfeeding for 6 months after birth, complementary between 6–8 months, and breastfeeding at 12 months.

We accounted our analyses for stunting status at 6 month of age, low birthweight, occurrence of pregnancy complications, frequency of antenatal visits (i.e. did or did not have ≥4 antenatal visits starting 1^{st} trimester), and occurrence of diarrhea within 7 days before the survey. We also measured and adjusted our analyses for socio-economic factor at baseline and during 12 month follow-up including income, and maternal and paternal education and employment status.

Data analysis

Multivariable linear regression was conducted to model LAZ and multivariate logistic regression was used to model the occurrence of stunting. To measure the relationship between repeat pregnancy and stunting persistence, we used multinomial logistic regression since persistence has four possible discrete outcomes (i.e. persistent, recovered, late incident, and normal). We considered repeated pregnancy as a count variable to enable comparison in an ordinal approach.

While interaction tests were performed to test differences by IPI and maternal age, mediation tests were conducted to account for low birthweight and poor feeding practices since birthweight is on the causal pathway between parity and stunting, and feeding practice variables are likely to have a modifiable impact on child stunting. Among feeding practice predictors, only breastfeeding at 12 months and complementary feeding were analyzed since the other two did not meet the requirements/assumptions for mediation test. We used Stata14 to perform mediation analysis bootstrapped with 10,000 simulations in beta coefficients. We used the binary_mediation macro in Stata14 which have adapted the standard Baron and Kenny set of equations to handle binary mediators in our study for continuous and discrete outcomes.[18]

Requirement for patient and public involvement

Patients were not involved in this study.

Results

Sample Characteristics

A total of 1033 mother-offspring dyads had complete LAZ data at both 12 and 24 month follow-ups. This consists of 299 <20 year old and 734 20–24 year old eligible women. **Table 5.2. 1** shows the participant characteristics by age group. Approximately 40% of the <20 year olds and 70% of 20–24 year olds had ≥1 pregnancy prior to the index child. More than 50% in both age groups had an IPI >24 months.

Overall, offspring of mothers aged <24 years old showed an average LAZ of -1.69 at 12 months and -2.35 at 24 months. Approximately 40% and 60% of the offspring were stunted at 12 and 24 months respectively. More than a third of the offspring sample showed persistent stunting from 12 through to 24 months of age.

Prevalence of Stunting

Offspring of young mothers with repeat pregnancies (i.e. with at least one past pregnancy) showed a higher prevalence of stunting and lower mean LAZ compared with offspring of mothers with no past pregnancy (**see Figure 5.2. 1**). There was a large difference in mean LAZ, from -1.53 among offspring of mothers with no past pregnancies to -2.09 among offspring of mothers with ≥3 pregnancies at 12 months and -2.10 among offspring of mothers with no past pregnancies to -2.77 among offspring of those with ≥3 pregnancies at 24 months. We also found that LAZ is slightly lower and stunting prevalence is slightly higher in <20 age group than in 20–24 age group particularly at 24 months (**see Figure S. 1**).

Occurrence and Persistence of Stunting Among Young Mothers with Repeated Pregnancies

Young mothers (≤24 years old) who experienced repeat pregnancy were more likely to have stunted offspring at both 12 and 24 months (**see Table 5.2. 2**). Offspring from a repeat pregnancy showed 40% (OR=1.40; 95%CI=1.18-1.66) risk to be stunted at 12 months and 25% (OR=1.25; 95%CI=1.04–1.50) at 24 months. The LAZ at 12 and 24 months in offspring of mothers who had experienced repeated pregnancies was at least 0.15 times lower compared to those of mothers who had had no previous pregnancies. We also observed a high risk of stunting persistence from 12 months to 24 months. A subsequent offspring showed 1.51 times the risk of persistent stunted growth [Relative Risk Ratio (RRR) =1.51; 95%CI=1.21–1.88] compared with offspring born to first time mothers.

No interactions were found by IPI. We also found null interactions and estimate overlaps by maternal age, both as continuous and categorical variables in the model. This suggests no substantive difference between the risk of offspring stunting in women aged <20 and 20–24 years (**see Table S. 3**). This was also confirmed by similar effect estimates and prevalence differences across number of past pregnancies for each age group.

Repeated Pregnancy and Stunting via Low birthweight and Feeding Practice

After confirming a strong direct effect of repeated pregnancy among young mothers on offspring stunting, we conducted a series of regression analyses to account for low birthweight and feeding practice as mediators. Infant feeding practices considered as mediators only included breastfeeding at 1 year and proper introduction of solid foods due to their strong associations with stunting outcomes.

Mediated effects showed that repeated pregnancy via low birthweight reduces LAZ by 0.16 units (adjusted β=-0.16; 95%CI=-0.24 – -0.08) at 12 months and 0.15 units (adjusted β=-0.15; 95%CI=-0.22– -0.07) at 24 months (**refer to Table 5.2. 3**). Mediation via feeding practices revealed minimal changes in the adjusted β. Using binary stunting outcomes consistently showed positive association with low proportion of mediation of <11% via low birthweight and <25% via feeding practices. In this analysis, we only analysed persistent stunting due to the null effects of repeated pregnancy to late incident and recovered stunting (**refer to Table 5.2. 3**).

Comment

Our study produced robust estimates to show that repeated pregnancy is a predictor for stunting after accounting for the effects of IPI, maternal age, low birthweight and feeding practices. Our finding contributes to strengthening the limited evidence on the impact of repeated pregnancy as a predictor of child health, with a particular focus on evidence from low- and middle-income countries.[19] We found that subsequent offspring of young mothers with repeated pregnancy are at increased stunting risk regardless of IPI, with ≥25% increased risk at 12 and 24 months compared to first-time young mothers.

In addition to stunting risks at two separate time points, subsequent offspring also showed higher risk of persistent stunting 12–24 months. This is of particular concern if one considers that children commonly have their best chance of recovering from stunting within the first two years of life.[20] Our findings on persistence of stunting during the first two years of life is supported by a cross-sectional analysis of 18 countries conducted by United Nations Children's Fund which showed an increased prevalence and reduced LAZ at 0–11 and 12–23 months among offspring of 15–19 year old mothers.[21] Another multi-country analysis of five cohort studies in developing countries also found similar results in its preliminary analysis; a decline in offspring's LAZ at two years by parity.[9] A multi-level meta-analysis also found subsequent pregnancy to influence delayed infant growth.[22]

The impact of repeated pregnancy on stunting can be explained by the 'dual-developmental crisis' experienced by young mothers during their subsequent conceptions.[23] [24] The ongoing nutritional requirement of young mothers due to puberty may deplete fetal nutrition causing low birthweight,[25] which we also found to be strongly associated with stunting in our study. Occurrence of another pregnancy may also disrupt young women's psychosocial adaptation, which may in turn result in poor health-seeking behavior on pregnancy nutrition,[26] poor infant feeding practices, and food insecurity within the household.[27] Because repeated pregnancies are often unintended,[28] young women may also be at risk of multiple psychosocial disadvantage including educational disruption, inadequate socio-economic resources, and poor human capital.[27] It has also been suggested that maternal inexperience, absence of autonomy, and poor hygiene may lead to suboptimum feeding, a precursor to stunting in the offspring.[9]

We found a mediating effect of birthweight and poor feeding practice in the association between repeated pregnancy and offspring stunting. In our study, low birthweight increased the risk of stunting in offspring born of a repeated pregnancy compared to offspring of first time mothers. This is supported by findings from a prospective cohort where young women with repeated pregnancy had a three-fold risk of low birthweight.[29]

Prevention and mitigation programs, especially in the first 1000 days of a child, are essential to revert these health and social burdens. Addressing low birthweight and suboptimal feeding practices, which are empirically identified in this study as mediators, may show promise for interventions and ultimately improve offspring's growth trajectories. Improving access to modern contraception among young women also contribute to reduce stunting risk.[30]

Our study adds to the existing literature through a rigorous method which allowed us to investigate this problem by accounting for the effects of important confounders and mediators. Our study also have some limitations. Due to insufficient statistical power particularly in <20 year olds, our study did not detect significant differences and mediation according to maternal age (**see Table S. 4**). Our models could not account for potential mediator-outcome confounders and consequent mediators between repeated pregnancy and stunting, such as the nutritional intake during pregnancy including supplements. We were also unable to explore potential mediation through feeding index to evaluate the timing, amount, frequency, and diversity of solid food introduced. Further we were not able to account for residual biological confounders which can be addressed through a comparative cluster analysis between the first and second child from a young mother.

Repeated pregnancy in young mothers is a predictor of child stunting. Subsequent offspring of young mothers were found to show persistent stunting from one to two years of age after consideration of mediation effects via low birthweight and feeding practices. Further research is needed to investigate and establish causal pathways and trajectories, which may clarify the unique pathogenesis of child stunting among young mothers.

Conflict of Interest: The authors report no conflict of interest.

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Ethical Approval: This study was approved by The University of Queensland School of Public Health Ethics Committee on April 11, 2016. The CLHNS surveys were reviewed and approved by the Institutional Review Board of the University of North Carolina at Chapel Hill.

Contributorship Statement:

Mr Maravilla conceptualized the study design; conducted data extraction, analysis and interpretation; drafted the initial manuscript, coordinated revision of the manuscript, and approved the final manuscript for submission.

Dr Betts contributed to the study design, data analysis and interpretation, critically reviewed and revised the manuscript, and approved the final manuscript for submission.

Prof Adair collected the data, contributed to the study design and reviewed and revised the manuscript, and approved the final manuscript for submission.

Prof Alati significantly contributed to the study design, analysis and interpretation, reviewed and revised the manuscript, and approved the final manuscript for submission.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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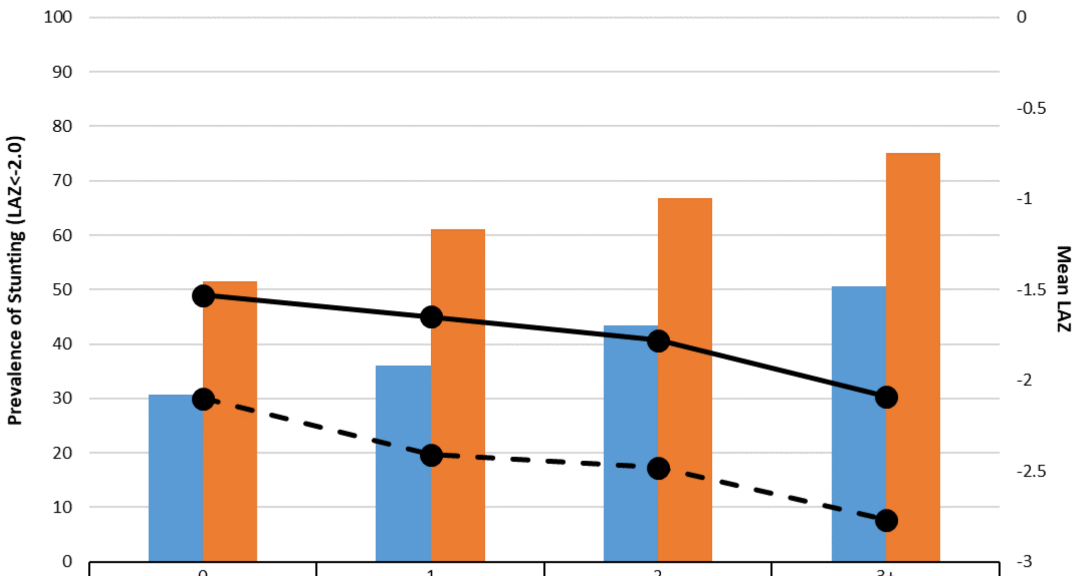

	0	1	2	3+
12 months	30.71	35.96	43.33	50.68
24 months	51.45	61.16	66.83	75.18
12 months	-1.53	-1.65	-1.78	-2.09
24 months	-2.1	-2.41	-2.48	-2.77

Number of Past Pregnancies

Figure 5.2. 1. Prevalence of stunting and mean length-for-age z scores (LAZ) at 12 and 24 month follow-up by number of past pregnancies in young mothers

Table 5.2. 1. Sample Characteristics

Measures	Overall (<25 years old)	Age Group	
		<20 years old	20-24 years old
Repeated pregnancies⁺			
0	530 (38.16)	254 (61.50)	276 (28.28)
1	418 (30.09)	120 (29.06)	298 (30.53)
2	256 (18.43)	33 (7.99)	223 (22.85)
3+	185 (13.32)	6 (1.45)	179 (18.34)
IPI⁺			
≤24 months	484 (38.23)	96 (25.20)	388 (43.84)
>24 months	782 (61.77)	258 (74.80)	497 (56.16)
LAZ at 12 months*	-1.69 (1.20)	-1.79 (1.13)	-1.65 (1.22)
Stunting at 12 months⁺	405 (37.43)	123 (39.05)	282 (36.77)
LAZ at 24 months*	-2.35 (1.10)	-2.43 (1.09)	-2.32 (1.11)
Stunting at 24 months⁺	654 (60.33)	202 (63.32)	452 (59.08)
Persistence of Stunting⁺			
Persistent	348 (33.69)	107 (35.79)	241 (32.83)
Late Incident	275 (26.62)	82 (27.42)	193 (26.29)
Recovered	39 (3.78)	10 (3.34)	29 (3.95)
Normal	371 (35.91)	100 (33.44)	271 (36.92)

Abbreviations: IPI-Inter-pregnancy interval; LAZ-Length-for-age Z-score
*Mean (Standard Deviation)
+Frequency (Proportion)

Table 5.2. 2. Occurrence and persistence of stunting in the first 24 months of life of offspring of young mothers aged <24 years old with repeated pregnancy

Outcomes	Univariate	Multivariate	Multivariate with RPxIPI$^{\%}$	Multivariate with RPxAge$^{\%}$	Multivariate with RPxAge$^{\%\&}$
LAZ at 12 months*$	**-0.15 (-0.21- -0.10)**	**-0.16 (-0.24- -0.09)**	0.45 (0.523)	0.10 (0.347)	0.01 (0.638)
Stunting at 12 months*@	**1.28 (1.16-1.43)**	**1.40 (1.18-1.66)**	0.86 (0.325)	0.06 (0.764)	0.04 (0.322)
LAZ at 24 months+$	**-0.20 (-0.26- -0.15)**	**-0.15 (-0.23- -0.08)**	0.09 (0.200)	0.16 (0.101)	0.01 (0.561)
Stunting at 24 months+@	**1.37 (1.23-1.54)**	**1.25 (1.04-1.50)**	0.89 (0.481)	-0.45 (0.081)	-0.02 (0.594)
Persistence of Stunting^?					
Persistent	**1.49 (1.31-1.71)**	**1.51 (1.21-1.88)**	0.82 (0.341)	0.68 (0.227)	0.99 (0.999)
Late Incident	**1.29 (1.12-1.49)**	1.12 (0.90-1.40)	0.82 (0.355)	**0.53 (0.037)**	0.99 (0.299)
Recovered	1.00 (0.73-1.39)	1.40 (0.89-2.18)	0.61 (0.303)	0.57 (0.293)	0.94 (0.479)

Abbreviations: IPI-Inter-pregnancy interval; LAZ-Length-for-age Z-score; RPxIPI- 2-way interaction between number of past pregnancies and IPI; IPI and Age group
*The multivariate model was adjusted for IPI, maternal age, maternal height, partner's age, birthweight, initiation of breastfeeding within 24 hours after delivery, consistent breastfeeding for 6 months after birth, breastfeeding at 12 months, and introduction of semi-solid and/or solid foods between 6–8 months, socio-economic characteristics, diarrhoea at 12 months, pregnancy complications and antenatal visits
+The multivariate model was adjusted for IPI, maternal age, maternal height, partner's age, birthweight, initiation of breastfeeding within 24 hours after delivery, consistent breastfeeding for 6 months after birth, breastfeeding at 12 months, and introduction of semi-solid and/or solid foods between 6–8 months, socio-economic characteristics, diarrhoea at 24 months, pregnancy complications and antenatal visits
^The multivariate model was adjusted for IPI, maternal age, maternal height, partner's age, birthweight, initiation of breastfeeding within 24 hours after delivery, consistent breastfeeding for 6 months after birth, breastfeeding at 12 months, and introduction of semi-solid and/or solid foods between 6–8 months, socio-economic characteristics, diarrhoea at 12 and 24 months, pregnancy complications and antenatal visits; Estimates are in regression coefficient (95% Confidence Interval); Reference group for outcome is 'Normal'
$Estimates are in Mean difference (95% Confidence Interval)
@Estimates are in Odds Ratio (95% Confidence Interval)
?Estimates are in Relative Risk Ratio (95% Confidence Interval)
%Interaction coefficient (p-value)
&Used age as continuous

Table 5.2. 3. Mediated effect of repeated pregnancy in young mothers and stunting via low birthweight and feeding practices in standardized regression coefficients and 95% confidence intervals

	via Low birthweight			via Feeding practices		
Outcomes	**Total Effect**	**Total Indirect Effect**	**%**	**Total Effect**	**Total Indirect Effect**	**%**
LAZ at 12 months[a*]	**-0.16 (-0.24 – -0.08)**	0.02 (-0.01 – 0.05)	10.81%	**-0.15 (-0.27 – -0.02)**	0.03 (-0.06 – 0.14)	20.13%
LAZ at 24 months[a+]	**-0.15 (-0.22– -0.07)**	0.02 (-0.01 – 0.05)	10.28%	**-0.13 (-0.27 – -0.01)**	0.03 (-0.08 – 0.14)	24.78%
Stunting at 12 months[b*]	**1.22 (1.08 – 1.35)**	0.98 (0.95 - 1.01)	7.87%	**1.20 (1.02 – 1.38)**	0.97 (0.86 – 1.06)	13.66%
Stunting at 24 months[b+]	**1.14 (1.01 – 1.30)**	0.99 (0.95 - 1.01)	10.56%	**1.13 (1.07 – 1.27)**	0.98 (0.88 – 1.07)	19.95%
Persistent Stunting[b^]	**1.30 (1.11 – 1.49)**	0.97 (0.92 – 1.01)	9.74%	**1.26 (0.94– 1.65)**	0.98 (0.76 – 1.26)	18.09%

Abbreviations: RP-Repeated pregnancy; IPI-Inter-pregnancy interval; LAZ-Length-for-age Z-score; %-Proportion mediated

[a]Regression coefficients and 95% confidence intervals

[b]Odd ratios and 95% confidence intervals

*Adjusted for IPI, maternal age and height, partner's age, birthweight, initiation of breastfeeding within 24 hours after delivery, consistent breastfeeding for 6 months after birth, breastfeeding at 12 months, and introduction of semi-solid and/or solid foods between 6–8 months, socio-economic characteristics, diarrhea at 12 months, pregnancy complications and antenatal visits

+Adjusted for IPI, maternal age and height, partner's age, birthweight, initiation of breastfeeding within 24 hours after delivery, consistent breastfeeding for 6 months after birth, breastfeeding at 12 months, and introduction of semi-solid and/or solid foods between 6–8 months, socio-economic characteristics, diarrhea at 24 months, pregnancy complications and antenatal visits

^Adjusted for IPI, maternal age and height, partner's age, birthweight, initiation of breastfeeding within 24 hours after delivery, consistent breastfeeding for 6 months after birth, breastfeeding at 12 months, and introduction of semi-solid and/or solid foods between 6–8 months, socio-economic characteristics, diarrhea at 12 and 24 months, pregnancy complications and antenatal visits

Summary

This chapter found that repeated pregnancy is a strong risk factor for adolescents' poor maternal outcomes and child stunting. Unlike older women, adolescents in their second pregnancy were highly at risk of complications of pregnancy (i.e. vaginal bleeding, headache, dizziness and/or peripheral oedema) or labour (i.e. prolonged labour, haemorrhage, sepsis and/or loss of consciousness). Repeated pregnancy also strongly predicted offspring stunting at 24 months in young mothers, adjusted for important covariates and mediation via low birthweight and poor feeding practice. I also found that subsequent children continued to be stunted from 12 to 24 months of age. Due to insufficient statistical power, no statistical difference was found between the significant effects of RP on adolescents' offspring and the significant effects of RP on young adults' offspring. However, by solely looking at the effect estimates in each age group, RP effects on stunting in adolescents is still two times higher than the older age group.

Chapter 6: Why do adolescents get pregnant again? Risk and protective factors of repeated adolescent pregnancy

Epidemiological studies in the previous chapters clearly established the magnitude and impact of repeated adolescent pregnancy (RP) in the Philippines. High RP prevalence (~20%) have been observed in the past two decades. This positions adolescent girls to experience high rates of pregnancy and labour complications [158]. Adolescents' subsequent children also show poor growth outcomes with lower length-for-age *z* score and higher stunting probability at 12 and 24 months.

Identification of RP predictors and correlates is an essential step to design preventative interventions. In this chapter, I further explore these factors in three levels (i.e. individual, interpersonal, and community levels) by conducting a meta-analytic review of 26 epidemiological research articles and pooling the effect estimates for 47 identified factors. This is described in detail in *Paper 6.1*.

I further explore specific characteristics of Filipino adolescent mothers and further group these characteristics into meaningful themes: obstetrics (i.e. individual), partner characteristics (i.e. interpersonal), and socio-economic status (i.e. community). This is discussed in detail in *Paper 6.2*.

6.1 Meta-analysis of factors influencing repeated adolescent pregnancy

Manuscript and formal citation

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Title:

Factors influencing repeated teenage pregnancy: a review and meta-analysis

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Condensation: Evidence suggest a link between poor obstetric outcomes, depression, school discontinuation, increased partner support and non-use of contraceptives and greater risk of repeated pregnancy among adolescents.

Short title: Factors influencing repeated teenage pregnancy

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Abstract

Objective: Existing evidence of predictors of repeated teenage pregnancy (RTP) has not been rigorously assessed. This systematic review provides a comprehensive evaluation of protective and risk factors associated with RTP through a meta-analytical consensus.

Data sources: Pubmed, EMBASE, CINAHL, ProQuest, PsychINFO, ScienceDirect, Scopus and Web of Science databases, from 1997 to 2015; and reference list of other relevant research papers and related reviews.

Study eligibility criteria: Eligibility criteria included 1) epidemiological studies which analysed factors associated with repeated pregnancy or birth among adolescents under 20 years of age who were nulliparous or experienced at least one pregnancy; 2) experimental studies with an observational component adjusted for the intervention.

Study appraisal and synthesis methods: We performed narrative synthesis of study characteristics, participant characteristics, study results and quality assessment. We also conducted random-effects and quality-effects meta-analyses with meta-regression to obtain pooled odds ratios (PORs) of identified factors, and determine sources of between-study heterogeneity.

Results: Twenty six eligible epidemiologic studies mostly from USA (n=24) showed over 47 factors with no evidence of publication bias for each meta-analysis. Use of contraception [pooled odds ratio (POR)=0.60, 95% confidence interval

(95%CI)=0.35-1.02] particularly long-acting reversible contraceptives (POR=0.19, 95%CI=0.08-0.45) considerably reduced RTP risk. Among studies concerning contraception, the number of follow-up visits (adjusted coefficient=0.72, p=0.102) and country of study (unadjusted coefficient= 2.57, permuted p=0.071) explained between-study heterogeneity. Education-related factors, including higher level of education (POR=0.74, 95%CI=0.60-0.91) and school continuation (POR=0.53, 95%CI=0.33-0.84), were found to be protective. Conversely, depression (POR=1.46, 95%CI=1.14-1.87), history of abortion (POR=1.66, 95%CI=1.08-2.54) and relationship factors, such as partner support, increased the RTP risk.

Conclusions: Contraceptive use, educational factors, depression and history of abortion are the highly influential predictors of RTP. However, there is a lack of epidemiological studies in low- and middle-income countries to measure the extent and characteristics of RTP across more varied settings.

Keywords: Adolescent; factors; meta-analysis; repeated teenage pregnancy; review; teenage pregnancy

Introduction

Teenage mothers have an elevated risk of repeated pregnancy (RTP) within two years of their first pregnancy.[1] Considering the impact of teenage pregnancy and childbirth on maternal deaths [2] and the debilitating effects on neonatal and child health outcomes, especially in low- and middle-income countries, [3-5] RTP leads to higher risk of preterm births [6], mental health issues [7] and developmental problems [8] among children. Compared to the first pregnancy (or teen pregnancy in general), RTP leads to higher risk of preterm births, mental health issues and developmental problems among children. Compared to the first pregnancy, RTP reflects not only the reproductive health status of adolescents but also the capacity of health systems to address the needs (i.e. education, social welfare) of adolescents after their first pregnancy. With these immense effects across life course, identifying the causes of RTP is essential to develop appropriate prevention strategies to reduce its occurrence.

The only systematic study which has exclusively reviewed RTP risk factors was conducted by Rigsby, et al. [9] in 1998. Rigsby, et al. [9] examined 20 studies from 1966-1997, and found 31 RTP predictors grouped according to family structure, psychological, educational, and obstetric and family planning characteristics. The review mainly identified studies with case-control or cross-sectional designs but did not perform a meta-analytic approach to produce aggregate estimates of risk factors, explore heterogeneity among study estimates, and include studies conducted in countries other than the USA. Knowing the high RTP rates among developing countries, [10-12] there is a need to contextualise RTP factors in this type of setting. RTP predictors may differ between developed and underdeveloped countries due to the unique socio-cultural characteristics of the latter. The influence of religion and community might affect service delivery and demand generation of family planning services to prevent repeated pregnancies.

Studies published after the 1998 review have suggested that mental health problems, [13,14], attitude to family planning, [5,15-18] romantic relationships, [10] intimate partner violence, [5,17] family support, [5] living arrangements, [16,19] income and education [5,20] [1,16] play a role in determining high RTP risk. On the other hand, there have been inconsistent findings as to the role of sexual behaviour, [21-23] self-esteem, [22,24-26] marital status, [16,17,27] parental monitoring, [28,29] race and religious affiliation. [14,26,27,30-32]

The complex nature of different RTP factors from individual to societal level can be structured through socio-ecological framework, [33] which has been commonly applied to better understand the broad literature on (first) teen pregnancy determinants.[34] A comprehensive up-to-date review adopting a quantitative approach is necessary to obtain a clearer synthesis of RTP factors and broaden the search to low- and middle-income countries in Asia-Pacific and African regions. In this paper, we reviewed and quantitatively synthesised various predictors of RTP from the current literature and analysed it using the socio-ecological framework. We used a rigorous approach to pool estimates from each study to identify if a factor has a protective, risk or null effect. We examined between-study heterogeneity of RTP risks as a function of study characteristics since heterogeneity may reflect methodological diversity [35] and direct future research to improve their methodology and design. Through these steps, modifiable and non-modifiable characteristics of RTP can be identified while targeting various risks and embanking on protective factors to facilitate the development of evidence-based programs.

Methods

Search strategy

We searched eight electronic databases including EMBASE, CINAHL, ProQuest, PsychINFO, PubMed, ScienceDirect, Scopus and Web of Science, using different key terms (i.e. factors, predictors, determinants, reduce, prevent, repeat, subsequent, multiple, second, young, teen, adolescent, pregnancy, birth, childbearing, and gravid) for studies published in English from 1997 to 2015 (the detailed search strategy and list of citations per database are available upon request). To widen the scope of our search strategy, we included grey literature, complete thesis documents, and reference list from other research papers and related reviews.

Screening and Selection

We followed the PRISMA guidelines [36] during the screening process while the MOOSE guidelines [37] were followed for the reporting of this review (refer to **Table S. 5** for the MOOSE checklist). After removing duplicates from the initial pool of searched articles, respective titles and abstract were screened for relevance following a detailed full-text screening. We included studies (1) with observational designs (i.e. cohort, case-control, cross-sectional), (2) aimed at identifying the different predictors of repeated pregnancy or birth, (3) among adolescents between 10 to 19 years old who were nulliparous or experienced at least one pregnancy. We avoided using an *a priori* list to saturate all documented factors. Nested observational studies (i.e. nested in experimental studies) with an analysis adjusted for any intervention were also included. Studies on repeated miscarriage or abortion, and adolescents with pre-existing conditions such as HIV and other infectious diseases were excluded. Those which included adolescents above 19 were considered if estimates from the teenage years could be obtained.

Data Extraction and Quality Assessment

Three reviewers (JCM, KSB, and CCC) independently abstracted data from all the articles while all (JCM, KSB, CCC and RA) cross-checked the study characteristics, participant information, results and identified limitations from each study. Risk of bias within each study were evaluated using The National Institutes of Health's tool for observational studies. [38] Quality score of each article was calculated by adding the number of criteria met as dictated by the assessment tool.

Predictors assessed in each study were examined and extracted together with their respective odds ratio (OR) and 95% confidence intervals (CI). Only those included in the final (i.e., adjusted) model of each study, except for intervention-related factors (in the case of experimental studies), were ascertained for our meta-analysis. If the predictors in the final models were not mentioned, all factors analysed were assumed to be in the final model. For studies which have assessed predictors at more than one time point, [14,22,25,39,40] we considered only the most recent OR since predictors with close temporality are more likely to have a higher impact on RTP. [17,41] For studies without reported ORs, we used the Practical Meta-analysis Effect Size Calculator, [42,43] EpiGearXL, [44] and a spreadsheet converter by DeCoseter [45] to carefully derive ORs from available data such as means, chi-square and point-biserial statistics. A p-value of 0.10 was assumed for studies which did not report any p-value, [46] and 0.04 for studies which reported a p-value of "<0.05". For categorical predictors, those with more than two categories were dichotomised since studies used different measures to operationalise a particular predictor. For example, some studies measured education as the highest educational attainment (i.e. primary, secondary, tertiary education) while others only used secondary education as the highest educational attainment (i.e. being a high school graduate or not). In this case, it was therefore necessary to pool the effects by collapsing secondary and tertiary education to achieve a single definition for this predictor (i.e. the effect of being at least a high school graduate) (see **Table S. 6** for the definition of each predictor).

Data analyses

Only those predictors assessed by at least two studies were considered for meta-analysis and arranged from protective factors to risk factors using the socio-ecologic framework. This framework includes five different components: individual factors, interpersonal factors (i.e. family, peers, relationship), community factors, multiple factors and family planning factors (i.e. which is considered to have cross-links with other components). [23,33] Separate meta-analysis, utilising random-effects modelling [35,47,48] was performed for each predictor identified, and the extent of heterogeneity was calculated using I^2 statistic and Cochran's Q at a 95% level of error. [49] Quality-effects meta-analysis was also done to examine how the quality of each study changed the pooled estimate compared to the results from random-effects meta-analysis. This analysis incorporates the quality score of each study in calculating the study weight, which is a robust and innovative technique to help minimize the estimator variance and account for subjectivity in quality assessment. [50] Publication bias was measured using the Egger's and Begg's tests. [48,49]

To further assess between-study heterogeneity, meta-regression was conducted for predictors which were included in at least eight studies, since a smaller number of studies may lead to unreliable results. [35,51,52] Year of publication (before 2001, 2001-2010, After 2010), country (USA, Brazil/Australia), setting (community-based, institution-based), design (cohort, case-control, cross-sectional), number of follow-ups (none, 1-2, 3-4, at least 5), quality score (continuous), type of outcome [non-rapid RTP (pregnancy or birth occurred more than 24 months after the first pregnancy), rapid RTP (pregnancy or birth occurred within 24 months after the first pregnancy)], type of predictors (categorical, continuous) and type of analyses (adjusted, unadjusted) were the methodological aspects considered as moderators for analyses in the meta-regression. The number of follow-ups excluded the baseline data collection. Derived estimates were considered unadjusted except for adjusted regression coefficients.

The residual maximum likelihood algorithm available in Stata (version 13) was used for the univariate random-effects meta-regression. This method maximizes the log likelihood of the residual (i.e., between-study variance) and approximates residual heterogeneity which is the study variance not explained by the moderators by assuming that the true effects follow a normal distribution. [35,48,51,53] Moreover, it also accounts for the degrees of freedom of categorical variables which prevents underestimation of regression coefficients. [48,54-56] The Knapp-Hartung variance estimator was applied to calculate p-values of each moderator while preventing false-positive results [57]. Because of the small number of studies, multiplicity adjustments with 10,000 permutations were also done for univariate analysis to reduce the standard error while estimating the variance during meta-regression. [54] Only moderators with p-values less than or equal to 0.20 in the initial model underwent multiplicity adjustment.

Although only univariate analysis is commonly performed when the number of studies is small, we conducted multivariate analysis with multiplicity adjustment to observe if any moderators strongly predicted the pooled estimates after adjustments, [35,48] using a backward stepwise approach. [58] Only moderators significant at the 0.10 level were included in this final model. Subgroup analyses were undertaken among significant moderators during univariate meta-regression to better visualise the differences among the pooled estimates.

Results

Eligible studies

A total of 4,397 articles were identified via our search strategy (see **Table S. 7**). After removing duplicates, the titles and abstracts of 2,874 studies were initially screened for relevance, resulting in the selection of 105 articles which subsequently underwent full-text eligibility screening using the inclusion criteria (refer to **Figure 6.1. 1**). Only 19 studies were deemed relevant and retained while the other papers were excluded due to non-relatedness, issues regarding the analysis of the predictor and outcome variables, and study design. In total, twenty six studies [13-15,17,21-32,39,40,45,59-66] were included in the analyses, with seven of these obtained via reference list of related studies.

Study characteristics and results

As shown in **Table 6.1. 1**, most of the studies (n=24) found were conducted in the USA except for Lewis [23] and de Fatima, et al. [64] which were from Australia and Brazil respectively. More than half (n=15) consisted of an institution-based sample, while the remaining 11 studies recruited participants from a community setting. Out of the 26 articles, 21 implemented a longitudinal cohort design, while three had cross-sectional designs and two were based on case-control designs. The number of follow-ups ranged from one up to 84 in the entire study duration. Nine of the 21 cohort studies followed-up adolescents for 24 months. The duration of the remaining studies varied between six months to a maximum of nine years.

Selected studies recruited adolescents during their first pregnancy or at most 18 weeks postpartum, with participants drawn from low-income or disadvantaged communities or from minority groups with disproportionately high teen pregnancy rate. Some studies had restrictive criteria such as receiving prenatal care (n=2), completed birth records (n=2), attending/ attended school (n=2), and unmarried (n=1). There were a total of 168,796 adolescents from all the studies, with individual studies ranging in size from 80 [39] to 146,206 [32] participants, and with an average response rate of 74.5%

A total of 92 variables were identified from the 26 eligible studies screened. Use of contraception (n=8), school continuation (n=8), age (n=10), age during first pregnancy (n=10) and race (n=10) were commonly assessed predictors. Evidence consistently showed that use of contraception, such as condoms, pills and subdermal implants, decreased the risk of RTP. Conversely, few studies confirmed the protective effect of school continuation after first pregnancy, and the negative effect of younger age and belonging to a minority group (i.e. indigenous peoples, African-Americans and Hispanics). Others had also demonstrated that adolescents with a history of abortion or miscarriage (n=6), a high depression score (n=5), and an experience of physical/sexual abuse (n=5) showed elevated risk of RTP.

Despite the negative impact of different mental health and behavioural issues, few studies investigated the association of these factors on RTP. [14,31,60] One study showed that aggression doubled the risk of RTP after multivariate analysis. Another study also found an association of suicidal ideation and psychiatric history with RTP. Contraceptive behaviour, in terms of consistency and reasons for non-use, was only examined by a single study which found non-use associated with three times the odds of RTP.

Predictors such as education, family planning and demographic characteristics were measured using a study-specific questionnaire while other variables were obtained through the use of validated scales such as Beck's depression inventory, Rosenberg's scale for self-esteem, and Rotter's measure for locus of control (see

Table S. 8). Most studies assessed the occurrence of pregnancy (n=20), birth (n=5) or both (n=1). Out of 20 studies, 15 measured rapid repeated pregnancy and five non-rapid repeated pregnancy. Four studies measured either rapid or non-rapid repeated birth while only one considered both rapid and non-rapid repeated birth.

There was an average quality score of 9.5 ranging from 7 to 13. Approximately half of the studies (n=11) achieved an above average score. Specific component scores showed that most studies failed to justify their sample size, maintained at least 80% retention/ response rate (n=19), measured their exposure variables more than once across time (n=6), and allowed for at least 24 months for RTP to occur (n=7). A few studies had a relatively small sample deemed inadequate to represent the relevant general population. Some longitudinal studies had high attrition rates. As to the data analysis performed, six studies conducted univariate analysis with no adjusting for confounders, while others presented adjusted estimates.

Meta-analyses of individual RTP factors

Out of 92 factors, 47 analysed by at least two studies were included in the meta-analysis (see **Figure 6.1. 2**). Meta-analyses of the identified family planning factors mostly revealed a protective influence on RTP. Use of long-acting reversible contraceptives (LARC) such as intrauterine device and implants reduced RTP risk by at least 80% (CI = 0.08-0.45). However, a borderline association was observed on contraceptive use in general (OR=0.60, CI=0.35-1.02).

Among the 22 individual factors, we found that discontinuation of attending school after the first pregnancy showed the strongest effect of 1.89 (CI=1.19-3.01). In addition, adolescents' obstetric history (i.e. multi parity and history of abortion/miscarriage) was found to increase RTP risk by 66%. Mental/behavioural-related predictors such as depressive symptoms and delinquent behaviour also influenced the odds of subsequent pregnancy. Characteristics of adolescent's partner were amongst the most important interpersonal factors for RTP occurrence. Partner-related predictors included wider age difference between adolescents and their partner, and perceived support from partners. Being married was not found to be linked to greater odds of RTP, whereas living with a partner increased RTP risk (OR=1.85; CI=1.38-2.48). Among the six community factors, only religious involvement (OR=1.19, CI=1.06-1.34) was associated with RTP.

Use of contraception, level of education, school drop-out, history of abortion/miscarriage and depression consistently showed an association both in narrative synthesis and meta-analyses. However, age, race and experience of physical/sexual abuse which seemed to be associated with RTP in narrative synthesis were found unrelated in meta-analysis.

Results from quality-effects meta-analysis (see **Table S. 10**) had a negligible impact on the direction and magnitude of the pooled estimates of all identified predictors from random-effects modelling except for the history of abortion/miscarriage. Further analysis on this predictor by excluding a study[63] with a low quality score due to low retention rate and statistical power and issues on temporality and analysis, improved the pooled OR from 1.44 (CI=0.90-2.30) to 1.34 (1.10-1.64). Excluding this study in random-effects analysis showed similar improvement from 1.66 to 1.37 (CI=1.12-1.67).

Almost 43% (n=20) of the factors analysed showed a low level of heterogeneity (see Table S. 9). Although this could be related to the small number of studies included for each factor, six predictors had at least five studies in the meta-analysis [i.e. alcohol use (I^2=0.00%), drug use (I^2=0.00%), smoking (I^2=0.00%), support from adolescent's mother (I^2=7.50%), depression (I^2=8.20%), and received insurance or subsidy (I^2=31.90%)]. No publication bias was detected across the 47 meta-analyses done.

Meta-regression and subgroup analyses

Only five factors, including age (n=10), age at conception (n=10), use of contraception (n=8), race (n=10) and school drop-out (n=8), qualified and underwent meta-regression (see **Table 6.1. 2**). Age, race, and school drop-out were not included in multivariate meta-regression because the nine moderators did not produce significant effects in the univariate analysis with or without multiplicity adjustments. Among the moderators analysed, only two (number of follow-ups and country type) were found to explain the heterogeneity among studies which considered the use of contraception. Increasing the number of follow-ups (Adjusted coefficient=0.72, CI=0.46-1.11, p-value=0.102) improved the positive effect of contraceptive use as did the exclusion of USA studies (Unadjusted coefficient= 0.39, CI=0.11-1.41, permuted p-value=0.071). Subgroup analyses (see **Table 6.1. 3**) further showed that more numerous follow-ups and the exclusion of non-USA studies reduced heterogeneity and improved the protective effect of contraception. Sensitivity analysis also showed similar findings upon removal of the Brazilian study by de Fatima, et al. [64] (refer to **Table S. 11**).

Although the type of predictor (permuted p-value=0.072) and outcome variable (permuted p-value=0.065) affected the effect estimate of age at first pregnancy in the univariate model, these effect was no longer seen after multivariate analysis. Findings from the subgroup and sensitivity analyses have also supported this results since no relevant changes in pooled OR and heterogeneity were observed.

Despite the small number of moderators (i.e. year of publication, number of follow-up, and country), the multivariate meta-regression model of the use of contraception had explained 68.65% of the existing study heterogeneity among 8 studies. On other hand, the multivariate model of the age during first pregnancy with two moderators explained 31.39%.

Comment

Main findings

In this study, we set out to identify factors affecting RTP using a systematic approach to aggregate the existing evidence. We identified a total of three protective and 12 risk factors of RTP primarily from cohort studies. Contraceptive use, particularly LARCs, and higher educational attainment were considered as strong protective factors. On the other hand, dropping-out of school, depression, obstetric history (i.e. history of abortion/miscarriage, multi parity, a first planned pregnancy), partner-related factors (i.e. wide age difference, increased partner support, living with a partner), being acquainted with other teen mothers, and increased religious involvement were found to increase RTP risk. This review also highlighted a lack of evidence on issues associated with RTP in developing countries. This is of concern if one considers that these countries have very high RTP rates ranging from 28%-60%-60% [10-12] when compared to 20% in the USA. [67]

Comparison with existing literature

Our review supports findings from earlier reviews [9,68] especially on the use of contraceptive implants as an example of LARC postpartum. The Meade, Ickovics [68] review suggested similar results, such that RTP is linked to previous miscarriage and being friends with pregnant teenagers. Our work is consistent with findings from Rigsby, et al. where school drop-out was an important RTP risk factor. Our findings did not support other findings of an association with age, income, smoking, and substance abuse, low socio-economic status and low educational level of parents, for which relationships were no longer seen after meta-analysis [5,9,68]. These discrepancies are possibly due to an increased methodological rigor in our study as previous analysis were purely based on narrative synthesis [9].

Implications

The pooled estimates we obtained emphasize the nature and magnitude of influence of each RTP factor. Despite the lack of studies from developing countries, our key findings could be relevant to specific issues such as contraception, education, abortion and mental health, which are of high concern in these countries.

Use of contraceptives particularly LARC, such as contraceptive subdermal implants and intra-uterine devices, during immediate postpartum showed the strongest protective effect against RTP. This could be due to the fact that continuous use of sub-dermal implants, unlike oral contraceptives [69] and condoms, [68] dramatically reduces the risk of non-compliance [17,61] and can highly prevent another pregnancy for up to three years. Moreover, implants are considered more accessible [70] especially in low-resource settings because frequent examinations and regular re-supply are unnecessary. Our findings also suggest the importance of frequent follow-up on accurate evaluation and consistent use of contraceptives for a longer period of time, since short-acting reversible contraceptives are still commonly used especially in developing countries. [71,72] Although contraception may show promising results to reduce RTP, the issue of reproductive coercion should be acknowledged and considered in evaluating contraceptive programs for adolescent mothers. This suggests the need for relevant counselling among service providers and health workers to draw attention to ethical issues around voluntary uptake of contraception.

While proper family planning practices are encouraged, exploring contraceptive behaviour through other RTP factors (e.g. consistency of contraceptive use, reasons for non-use) would facilitate designing promotion strategies particularly in countries with unique cultural complexities. However, most of the studies reviewed did not consider the possible mediating effect of family planning despite some evidence suggesting the cross-linking influence of family planning attitude in different levels (i.e. individual, interpersonal, community). [33,73] Performing a mediation analysis would allow one to measure the total effects of other exposure variables, which account for the direct and indirect effects of the exposure variables through the family planning characteristics.

Educational status, particularly continuous school attendance and attaining at least secondary education, showed a protective role against RTP. It has been argued that being involved in studying may help adolescent mothers to identify new career goals.[9] This suggests that a supportive school environment, with specific school curricula as well as "peer education" initiatives [74-76] for first time mothers/ pregnant adolescents may encourage school retention and ultimately the development of alternative goals and opportunities.

Increased partner support was a risk factor for RTP in this study. This is a counter-intuitive finding which deserve additional research attention. Partner-related characteristics such as intimate partner violence and marital status may be at play because of the strong yet borderline significant relationship of physical/sexual abuse and the conflicting effects of being married versus living together respectively found in this review. This may also be related to not plan a pregnancy because of a partner's desire to have another child. This may be supported by a study which found that partners wanting another child doubled the risk of an intended RTP.[27] This are however a speculative interpretations. More observational studies with repeated follow-up designs are needed to clarify these findings and exploring the nature of support given by the partner in family planning.

Adolescents with a history of abortion and depression were found to be at higher risk for RTP. Abortion may lead to wanting another pregnancy to cope with a sense of loss [63], while depression, which is prevalent among teen mothers [77] and may partly result from unintended pregnancy, [78] may lead to risky sexual practices and poor contraceptive use [13]. These findings suggest the need for psychological interventions for adolescents when depressive symptoms and emotional distress are identified. This aspect of postpartum care can be encouraged especially among adolescent mothers with low socio-economic status wherein mental health intervention is often neglected and hardly accessible. [79]

One of the aim of this review was to identify much needed evidence on RTP in low- and middle-income countries. We found no published studies of RTP in Asia-Pacific and Africa where adolescent fertility is high [80] and family planning services are often inaccessible. [81] Cross-sectional investigations utilising existing national survey data are urgently needed to ascertain the extent of global risk associated with RTP. Local studies, due to the distinct socio-cultural characteristics of developing countries, may show the role of specific factors which were found to have null effect (i.e. religion, race/ethnicity, income/ socio-economic class, and sexual behaviour) and not well analysed in our review due to lack of studies (i.e. aggression, history of psychiatric illness, suicidal ideation, and contraceptive behaviour). Studies based in these settings would make an important contribution towards a generalizable evidence necessary in formulating RTP interventions and strategies and improve adolescent reproductive health globally.

Strengths and limitations

This meta-analytic review provides the first comprehensive evaluation of risk and protective factors for RTP. We identified an extensive and up-to-date pool of studies beyond those analysed in the systematic review undertaken by Rigsby, et al. in

1998. We mostly reviewed cohort studies, which made the pooled estimates more reliable and increase our confidence towards assumptions of causal inference.

Ours was not only the first study to perform meta-analysis on this topic, but also to undertake multiple meta-analyses by pooling estimates for each of the 47 factors. In addition, we also assessed the magnitude and sources of heterogeneity through meta-regression while employing permutations during the univariate analysis to prevent Type I Error. This series of analyses and subsequent subgroup analyses showed how the different study characteristics affected the between-study heterogeneity, specifically the effect of the number of follow-ups on the effect size of contraceptive use.

In spite of our study's novelty, results from this review cannot be generalised to low and middle-income countries since most of the studies we found were conducted in the USA. Although we identified four Latin American studies with an eligible abstract, these studies have no available in English-translated full-text. This limitation was also noted in previous aggregate studies. [9,68] In addition, the 26 studies we found only allowed us to pool a maximum of 10 studies per factor, which had led to the further reduction of studies per level of each moderator during meta-regression. This may result in insufficient power to detect an association despite the consistency of results of meta-regression with subgroup analysis. Also we have may had insufficient power to detect an effect for factors such as use of LARC, parity, planned first pregnancy and presence of multiple risk factors because of the small number of studies pooled.

In conclusion, our review has found protective role of contraceptives, especially LARC, and continuation of education until tertiary level. Depression, partner's support and abortion as risk factors suggest a need for postpartum psychosocial interventions and partners' involvement in family planning counselling. Lastly and importantly, this review has shown epidemiological studies in developing countries, where RTP are highly prevalent, are sorely needed to establish essential local evidence for policy and program development at the national and international level.

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Table 6.1. 1. Study characteristics and results

Authors (Year)	Location (Setting)	Design (# ff, l ff)	Inclusion criteria (Final sample size, Response/retention rate)	Outcomes (Definition)	Significant predictors (Effect sizes)	Key findings	Qi
Barnet, et al. (2008)	USA (CB)	Ch (2, 24m)	Pregnant adolescents, aged 12-18 years with low income at community-based prenatal care sites with guardian consent in case living in a foster care (245, 75%)	RRP (Occurrence of repeated pregnancy by 2y postpartum)	**Mental health status:** Depressive symptoms (AHR)	Depressive symptoms has a significantly increased the chance of rapid repeat pregnancy. It was also found that demographic characteristics and other proximal and distal indicators had no confounding effects on this relationship. Condom use and being in school had similar effect on repeated pregnancy.	**12**
Bennett, et al. (2013)	USA (CB)	Ch (2, 7y)	Seventh grader from the public school system whom data are linked to birth record who have live births before 20 years of age (12,339, 93%)	RB (Second birth before 20 years old)	**Education:** 7th grade reading skill level (chi2)	Having an above literacy level as well as being a white American or Asian were the protective factors for repeated pregnancy.	**9**
Black, et al. (2006)	USA (IB)	Ch from an experimental study (3, 24m)	Under 18 years old at delivery of the first child, black race, no indication of cocaine and heroin use in the medical chart, no chronic illness that would interfere parenting or adolescent development; infants of the mother is term and of normal birthweight with no congenital problems, chronic illness or disabilities	RRB (Second birth 24m after the delivery of the first child)	**Personality:** Positive life events (AOR)	During baseline, it was found that older adolescent mother has higher tendency to have another pregnancy. Upon assessment of the factors during 24th month follow-up, having positive life events during the past year significantly was associated with having another infant.	**12**

Authors (Year)	Location (Setting)	Design (# ff, l ff)	Inclusion criteria (Final sample size, Response/retention rate)	Outcomes (Definition)	Significant predictors (Effect sizes)	Key findings	Qi
			(149, 82.32%)				
Boardman, et al. (2006)	USA (CB)	CS (na)	At most 30 years women who experienced at least one pregnancy as an adolescent (aged 19 years or younger), or interviewed at least 24m since the resolution of pregnancy (1,117, 15%)	Intended or unintended RRP(Intended or unintended second pregnancy experienced by adolescent within 24m of the resolution of the first pregnancy which could have ended in miscarriage, elective abortion, ectopic pregnancy, preterm or term stillbirth, or preterm or term live birth)	**Sexual behaviour:** First pregnancy intended by teen, Age at first conception **Obstetric history:** Prior poor obstetric outcome **Parent relationship and support:** Did not live in 2-parent household as teen **Partner relationship and support:** Second pregnancy intended by partner, Married at second conception **Community involvement:** Religion in which raised (AOR)	Absence of religious affiliation or being a Roman Catholic when raised, living in a two-parent household, good obstetric outcomes and unintended first pregnancy on the side of the teenager and her partner decreased likelihood of intended rapid repeat pregnancy. Having a younger age (below 15 years old), raised as Roman Catholic, living in a two-parent household, and being married at time of second conception, good obstetrical outcome and intact family dynamics also had similar relationship with unintended rapid repeat pregnancy.	**13**
Coard, et al. (2000)	USA (IB)	Ch (2, 24m)	First-time adolescent mother between 1-16 weeks postpartum (80, 82.5%)	RRP (Repeated pregnancy within 1y or between 1y-2y postpartum)	**Socio-demographic:** Age (r) **Obstetric history:** Number of lifetime miscarriage (r) **Contraceptive use:** Current contraceptive use, Current contraceptive method (chi2)	It was found that 34% of adolescent mothers experienced repeat pregnancy at 24 months. Contraceptive use, maternal age, history of miscarriages and postpartum contraceptive use significantly predicted the occurrence repeat pregnancy.	**9**
Crittenden, et al. (2009)	USA (IB)	Ch (2, 24m)	Aged 19 years or younger, with less than 29 weeks gestation, had no previous live births, had at least two sociodemographic risk	RRP (Occurrence of pregnancy within 24m of the previous pregnancy)	**Personality:** Attitude towards aggression, Perceived self-efficacy to not be aggressive **Socio-demographic:** Age at first period (AOR)	Age at first period, level of education, drug use, aggression and depression were significant during the full main effects model. However, only aggression proxies and age at first period	**10**

Authors (Year)	Location (Setting)	Design (# ff, l ff)	Inclusion criteria (Final sample size, Response/retention rate)	Outcomes (Definition)	Significant predictors (Effect sizes)	Key findings	Qi
			characteristics (unmarried, 12 years of education, or unemployed) and received no nurse home visitation services (354, 99%)			were significant after stepwise modeling.	
Crosby, et al. (2002)	USA (IB)	Ch (1, 6m)	African-American, aged between 14 and 18 years during enrolment, sexually active in the previous six months, and provided written informed consent (410, 78.6%)	RRP (Occurrence of another pregnancy after 6m postpartum of the first pregnancy)	**Parent relationship and support:** Perceived parental monitoring (AOR)	Perceived less parental monitoring predicted adolescent pregnancy.	**9**
Damle, et al. (2015)	USA (IB)	Ch (every clinical visit, 24m)	First-time adolescent mothers at most 19 years old who received prenatal care and delivered their first child, excludes who had preterm deliveries (340, 80%)	RRP (Another pregnancy within 2y after the first child)	**Parenting behaviour:** Attended postpartum visit within 8 weeks **Contraceptive use:** Contraception not initiated prior to discharge postpartum, LARC initiation by 8 weeks postpartum (AOR)	One in every three teen mothers had another pregnancy within two years with a mean interception interval of 10 months. Early initiation of contraceptives and more postpartum follow-ups can diminish the chance for these mothers to be pregnant again.	**9**
Davis (2002)	USA (CB)	Ch (5, 6y)	Under 19 never being married prior to event of the next pregnancy (278, nd)	RP (Occurrence of another pregnancy among unwed adolescent mothers)	**Personality:** Educational aspirations **Sexual behaviour** Age at birth of first birth **Parent relationship and support** Kin co-residence (AOR)	Adolescent mother who are 16 years old or younger, with low educational expectations and those living with mother's kin were more likely to have second child within 2 years than the younger teens.	**8**

Authors (Year)	Location (Setting)	Design (# ff, l ff)	Inclusion criteria (Final sample size, Response/retention rate)	Outcomes (Definition)	Significant predictors (Effect sizes)	Key findings	Qi
De Fatima, et al. (2012)	Brazil (IB)	CS (na)	Pregnant teenagers in hospital obstetric center (245, 75%)	RP (Having two or more pregnancies)	**Sexual behaviour:** Age at first pregnancy **Parenting Behaviour:** Prenatal examinations **Partner relationship and support:** Living with partner **Education:** Years of education **Socio-economic status:** Monthly income **Contraceptive use:** Contraceptive method (AOR)	Socio-demographic advantages and prenatal health services utilization are found to be protective factors for repeat pregnancies. Surprisingly, contraceptives use predicts repeat pregnancies as is living with partner.	**7**
Gillmore, et al. (1997)	USA (IB)	Ch (5, 18m)	At least 17 years old, not married, and pregnant but planned to carry their pregnancy until term (170, 71%)	RRP (Another pregnancy that occurs within 18m after the first birth)	**Sexual behaviour:** Age at birth of first child, Frequency of intercourse **Partner relationship and support:** Length of relationship **Friend characteristics:** Best friend ever pregnant **Contraceptive use:** Use of contraception (AOR)	Contraceptive use and frequency of intercourse were only the significant proximate determinants of repeated teenage pregnancy regardless of racial disparities.	**9**
Gray, et al. (2006)	USA (IB)	Ch (3, 24m)	Indigent and primiparous adolescent below 20 years of age (111, nd)	RRP (Become pregnant again either between 0m-6m, 7m-12m, 13m-24m)	**Race:** Race **Contraceptive use:** Early use of contraception **Intention to have another pregnancy:** Prenatal contraceptive plan (chi2)	Teenagers who are in school or high school graduate and who have a contraceptive postpartum plan were less likely to have another pregnancy within 6 months, and between 7-12 months. Being married increased the risk instead.	**9**
Jacoby, et al. (1999)	USA (IB)	CC (2, 18m)	Received prenatal care between 13-21 years old	RRP (Pregnancy 12m or 24m after the previous	**Obstetric history:** Spontaneous abortion **Experience of abuse:** Any form of physical or	Only physical violence, sexual violence and spontaneous abortion had increased	**5**

Authors (Year)	Location (Setting)	Design (# ff, l ff)	Inclusion criteria (Final sample size, Response/retention rate)	Outcomes (Definition)	Significant predictors (Effect sizes)	Key findings	Qi
			(100, nd)	pregnancy)	sexual violence during study period (OR)	association with rapid repeat pregnancy in 12 and 18 months.	
Lewis, et al. (2010)	Australia (IB)	Ch (9, 24m)	Nulliparous English speaking teenagers at most 18 years of age who has an appointment with the adolescent antenatal clinic, but does not surrendered first infant into an adoption or social services (109, 74%)	RRP (Teen mothers who experiences a pregnancy within 2y of a first teen birth)	**Sexual behaviour:** Ongoing sexual intercourse over 3 months **S/Race:** Indigenous Australian **Contraceptive use:** Contraception **Intention to have another pregnancy:** Intends to become pregnant (AOR)	Current use of long acting contraceptives reduce the incidence of rapid repeat pregnancy by 73%. Those using oral contraceptives had similar effect as those who are not using. Other factors such as being sexually active, intending to become pregnant again and being an indigenous Australian significantly amplified the odds by 3-8 folds.	**13**
Manlove, et al. (2000)	USA (CB)	Ch (3, 6y)	Students enrolled in 8th grade last 1988 (564, nd)	RB and RRB (Second birth at the 24th month assessment or at any time since the birth of the first child among teenagers)	**Sexual behaviour:** Age at first birth **Partner relationship and support:** Father of child helped with care **Education and employment:** Enrolled in gifted class, Educational achievement after first birth, Employed or enrolled after first birth (AOR)	Low socioeconomic status and not being in a nuclear family increased risk of rapid subsequent pregnancy. Black American and with poor educational status/ condition were also at high risk Paternal involvement in child care as well as mother's involvement in any community activities had lowered the chance for the mother to have another pregnancy.	**11**
Milbrook (2013)	USA (CB)	Ch (every m, 7y)	Adolescents having least one pregnancy before 20 (100, nd)	RP (Number of pregnancy before age of 21 from enrolment)	**Sexual behaviour:** Age at birth of first child **Community involvement:** Placement change, Case manager change (ASB)	Less stable placements, case management relationships, school placements and number of children had positive relationship with number of pregnancies; thus, add the risk of repeated	**7**

Authors (Year)	Location (Setting)	Design (# ff, l ff)	Inclusion criteria (Final sample size, Response/retention rate)	Outcomes (Definition)	Significant predictors (Effect sizes)	Key findings	Qi
						teen pregnancy. Regression analyses of these three factors explained 22.1% of outcome variance.	
Montgomery (2010)	USA (CB)	Ch (4, 9y)	Adolescents aged 9-19 years living in the 13 most impoverished place in Alabama, reported gender consistently over time, and participated in at least 3 consecutive data collection (135, nd)	RRP (Reporting of one pregnancy with an additional pregnancy within 2y after the first)	**Problem behaviour:** Suspension or expulsion **Socio-demographic:** Age **Sexual behaviour:** Boy having sex proves he is a man, Frequency and recency of sexual intercourse **Community Involvement:** Involved in organized activities (AOR)	Age, frequency and recency of sex after first pregnancy, as well as being suspended or expelled from school were the most positive prominent predictors of repeat pregnancy among adolescents. Adolescents who had repeat pregnancy tend to be 2 years older. Adolescent mothers who believe that boy having sex proves manhood had 5 times chance of another conception. Unlike the first pregnancy, pregnancy intention, number of sexual partners and having discussion with parents about sex were found as non-significant predictors.	**11**
Patel, et al. (1997)	USA (CB)	CS (na)	Adolescent less than 20 years old with pregnancy resulting in a singleton or multiple livebirths in Illinois, but excludes adolescents with low birth weight infants or preterm births (146,206, nd)	RP (Teenagers with at least 1 live birth from multiple gestation)	**Socio-demographic:** Maternal age **Obstetric history:** Parity **Race:** Race (chi2)	Occurrence of repeat pregnancy was significantly related to race and parity. White Americans had longer birth intervals compared to whites. An increase in parity also increase chance for another pregnancy among below 20.	**7**
Pfitzner, et al.	USA (IB)	CC (1, 24m)	Teenagers who entered and exited	RP (Teenagers who	**Socio-demographic:** Maternal age at entry,	Repeaters tend to be younger upon enrolment	**8**

Authors (Year)	Location (Setting)	Design (# ff, l ff)	Inclusion criteria (Final sample size, Response/retention rate)	Outcomes (Definition)	Significant predictors (Effect sizes)	Key findings	Qi
(2003)			the teen program between 1985 and 2000 (1,107, 60.22%)	experienced a repeat pregnancy)	Maternal age at exit (F) **Mental health status:** Suicidality, Significant Psychiatric history (chi2) **Parenting behaviour:** Placed child for adoption (chi2) **Obstetric history:** Pregnancy outcome (chi2) **Sexual behavior:** Maternal age at delivery (F) **Partner relationship and support:** Relationship at conception, Paternal ethnicity, Relationship which father of baby at exit (chi2) **Community involvement:** Time in program (F), Exit reason (chi2) **Education and employment:** Last grade completed (F) **S/Race:** Maternal ethnicity (chi2)	also older upon exiting the study. They also had psychiatric history with frequent attempt of suicide. They were less likely to place their child for adoption yet more likely to be in committed relationship Being a Hispanic or having Hispanic partner increased that chance of the teenager to be a repeater as well as not being enrolled in school.	
Raneri and Wiemann (2007)	USA (IB)	Ch (8, 4y)	Teens who considered themselves as Black, Mexican, or White, planned to retain custody of the child, could read and write English or Spanish, fifth-grade level in either, and had no major psychiatric disorder (581, 62.34%)	RRP (Subsequent pregnancy or birth on one or more surveys within 24m)	**Partner relationship and support:** Age of father of first child, Not in a relationship with father of first child 3 months after delivery, Hit by boyfriend/husband within 3 months after delivery **Peer characteristics:** At least half of friends were teenage mothers at delivery **Education:** Enrolled in school **Contraceptive use:** Not given long-acting	Almost half of the first adolescent mothers had another pregnancy. Among the individual predictors, having a plan to have another child within five years and not using a long acting contraceptive within three months of delivery increased the odds of repeat pregnancy. Among dyad-level predictors were not, being in a relationship with the father of the first child three months after delivery, being more than	**12**

Authors (Year)	Location (Setting)	Design (# ff, l ff)	Inclusion criteria (Final sample size, Response/retention rate)	Outcomes (Definition)	Significant predictors (Effect sizes)	Key findings	Qi
					contraceptive within 3 months after delivery **Intention to have another pregnancy:** Intention to have pregnancy (AOR)	three years younger than the first child's father, and experiencing intimate partner violence within three months after delivery also has similar relationship. Not being in school three months postpartum and having many friends who were adolescent parents also heightened the risk unlike other peer/community level determinants.	
Richio, et al. (2010)	USA (CB)	Ch (1, 24m)	Teens aged at most 19 having first singleton births having birth records (899, nd)	RRB (Repeat births within 2y after first birth)	None	There was no significant difference between the rate of repeat pregnancy among those with history of spontaneous vaginal delivery and caesarean delivery.	**8**
Sangalang, et al. (2006)	USA (CB)	Ch (2, 4y)	Adolescent singleton mothers aged between 12-19 years who have complete birth records in North Carolina registry (2,250, nd)	RB (Occurrence of second birth)	**Race:** Race (ARR)	Race specifically not being a white American raised the risk of second birth among 12-16 years old mothers.	**11**
Sims and Luster (2002)	USA (CB)	Ch (2, 24m)	Below 20 years old who are currently pregnant at the time of enrolment (99, 69.70%)	RRP (Occurrence of pregnancy at the 24th m of assessment at any time since the birth of the first child) RRB (Occurrence of birth	**Mental Health Status:** Personal resources **Personality:** Locus of control (AOR)	Personal resources of the adolescent in terms of support and motivation lowered the risk of having another pregnancy (OR=0.41, 95%CI=0.22-0.74) and birth (OR=0.30; 95%CI=0.15-0.61). Only 52% of mothers living with their partner did another pregnancy compared to 62% among those who don't. An	**10**

Authors (Year)	Location (Setting)	Design (# ff, l ff)	Inclusion criteria (Final sample size, Response/retention rate)	Outcomes (Definition)	Significant predictors (Effect sizes)	Key findings	Qi
				at the 24th m of assessment at any time since the birth of the first child)		increase in locus of control heightened the odds of repeated births by 50%. All other variables were not significant predictors.	
Steven-Simon, et al. (1998)	USA (IB)	Ch (3, 18m)	Poor and nulliparous pregnant adolescents, excludes those pregnancy which are result of rape (165, 83%)	RRP (Occurrence of another within 18m of study)	**Education:** School drop-out **Contraceptive use:** Inconsistent contraceptive use "harder-to-modify" explanation (AOR)	School-drop outs and inconsistent use of contraceptives with "harder-to-modify" explanation increased the odds of having a repeated conception.	**7**
Stevens-Simon, et al. (2001)	USA (IB)	Ch (3, 24m)	Poor and nulliparous pregnant adolescents (286, 76%)	RRP (Another pregnancy 24m from the first delivery)	**Physical/Mental Health:** Number of risk factors present **Contraceptive use:** Use of Norplant, Use of Depo-Provera during the puerperium (ARR)	Failure to use Norplant and Depo-Provera, as well as having more than nine risk factors of repeat pregnancy had positive association with repeat pregnancy.	**9**
Tocce, et al. (2012)	USA (IB)	Ch (2, 3.5m)	Poor and nulliparous pregnant adolescents, does not include those with contraindication to etonogestrel as well stillbirths (357, 90.15%)	RRP (Repeat pregnancy 12m after delivery	**Obstetric history:** Primiparity **Contraceptive use:** Not receiving Immediate Postpartum Implantation insertion (AOR)	There is a significant 8 fold risk for repeat pregnancy among those who are not using contraceptive implants.	**12**

Design: CC, case-control; Ch, cohort; CS, cross-sectional
Setting: CB, community-based; IB, institution-based
Outcomes: RB, non-rapid repeated birth; RP, non-rapid repeated pregnancy; RRB, rapid repeated birth; RRP, rapid repeated pregnancy; m, months; y, years; na, not applicable; nd, no data; # ff, number of follow-up; l ff, length of follow-up
Effect size: AHR-adjusted hazard ratio; AOR, adjusted odds ratio; ARR, adjusted relative risk; ASB, adjusted standardized beta; chi2, chi-square coefficient; F, F statistic; OR, Odds ratio; r, Correlation coefficient; t, t statistic
Qi, Quality score

Table 6.1. 2. Random-effects meta-regression of selected factors of repeated teenage pregnancy

Factors[a]	Moderators[b]	Univariate Analysis[c] Exp (B) (95% CI)	Univariate Analysis[c] p-value (p*)	Multivariate Analysis[d] Exp (B) (95% CI)	Multivariate Analysis[d] p-value (p*)	R^2
Age during first conception	Type of predictor Continuous *(Ref. Categorical)*	0.46 (0.17-1.27)	0.115 (0.072)	0.55 (0.15-1.95)	0.297 (0.487)	31.39%
	Outcome variable Rapid RTP *(Ref. Non-Rapid RTP)*	1.24 (0.87-1.76)	0.195 (0.065)	1.31 (0.48-3.59)	0.549 (0.570)	
School drop-out	Number of follow-up points	0.71 (0.43-1.18)	0.149 (0.201)	-	-	
	Type of predictor Continuous *(Ref. Categorical)*	0.32 (0.63-1.60)	0.134 (0.249)	-	-	
	Country USA *(Ref. Brazil/ Australia)*	0.29 (0.09-0.85-)	0.036 (0.125)	-	-	
Use of contraception	Year of publication	1.80 (0.80-4.03)	0.127 (0.109)	1.29 (0.59-2.79)	0.417 (0.689)	68.65%
	Number of follow-up points	0.65 (0.42-1.03)	0.061 (0.032)	0.72 (0.46-1.11)	0.102 (0.248)	
	Country	0.39	0.122 (0.071)	0.55	0.232 (0.439)	

Factors[a]	Moderators[b]	Univariate Analysis[c] Exp (B) (95% CI)	Univariate Analysis[c] p-value (p*)	Multivariate Analysis[d] Exp (B) (95% CI)	Multivariate Analysis[d] p-value (p*)	R^2
	USA *(Ref. Brazil/ Australia)*	(0.11-1.41)		(0.16-1.79)		
	Design	0.18	0.004 (0.128)	-	-	
	Cohort *(Ref. Non-cohort)*	(0.07-0.45)				
	Outcome variable	0.18	0.004 (0.128)	-	-	
	Rapid RTP *(Ref. Non-Rapid RTP)*	(0.07-0.45)				

Exp(B), regression coefficient; SE, standard error; p*, permuted p-value; R^2, Proportion of between-study heterogeneity explained
[a] List of factors which underwent meta-regression for moderator analysis; age of the teenager and race did not have significant moderators in the initial model; [b] Moderators which has a p-value of at least 0.20 in univariate analysis; [c] Univariate analysis with multiplicity adjustments using 10,000 permutations; [d] Multivariate analysis with multiplicity adjustment using moderators which have a p-value of at least 0.10

Table 6.1. 3. Subgroup analysis of age during pregnancy and use of contraception: Random-effects and quality-effects model

		Pooled Estimate								
		Random-effect model			Quality-effects model			Heterogeneity		
Subgroups[a]	n	OR	LCI	HCI	OR	LCI	HCI	Q	p	I^2
A. Age during first pregnancy										
Type of predictor										
Continuous	8	0.90	0.79	1.03	1.03	0.86	1.23	60.74	<0.001	88%
Categorical	2	1.80	1.20	2.69	1.67	1.08	2.56	1.55	0.21	35%
Outcome										
Non-Rapid RTP	5	0.78	0.57	1.07	1.03	0.59	1.82	51.78	<0.001	92%
Rapid RTP	5	1.36	0.95	1.94	1.11	0.64	1.91	22.60	<0.001	82%
OVERALL	**10**	**0.99**	**0.87**	**1.13**	**1.06**	**0.88**	**1.27**	**7.71**	**<0.001**	**88%**
B. Use of Contraception										
Country										
USA	6	0.49	0.35	0.69	0.51	0.36	0.73	12.15	0.03	59%
Brazil/Australia	2	1.17	0.21	6.43	1.08	0.20	5.97	21.92	<0.001	95%
Number of follow-up										
None	1	2.76	1.81	4.22	2.76	1.81	4.22	-	-	-
1-2	3	0.58	0.32	1.04	0.84	0.32	2.18	38.87	<0.001	92%

Subgroups[a]	n	Pooled Estimate								
		Random-effect model			Quality-effects model			Heterogeneity		
		OR	LCI	HCI	OR	LCI	HCI	Q	p	I^2
3-4	1	0.36	0.16	0.80	0.36	0.16	0.80	-	-	-
5 and above	3	0.43	0.33	0.57	0.44	0.33	0.48	0.21	0.90	0%
Year of publication										
Before 2001	2	0.40	0.29	0.56	0.40	0.29	0.56	0.75	0.39	0%
2001-2010	4	0.59	0.40	0.86	0.60	0.40	0.89	6.67	0.08	55%
After 2010	2	1.08	0.17	7.00	1.26	0.19	8.43	25.22	<0.001	96%
OVERALL	**8**	**0.60**	**0.35**	**1.02**	**0.61**	**0.34**	**1.08**	**62.49**	**<0.001**	**89%**

n, number of studies; OR, odds ratio; LCI, lower 95% confidence interval; HCI, lower 95% confidence interval; p, p-value
[a] Moderators analysed in multivariate meta-regression

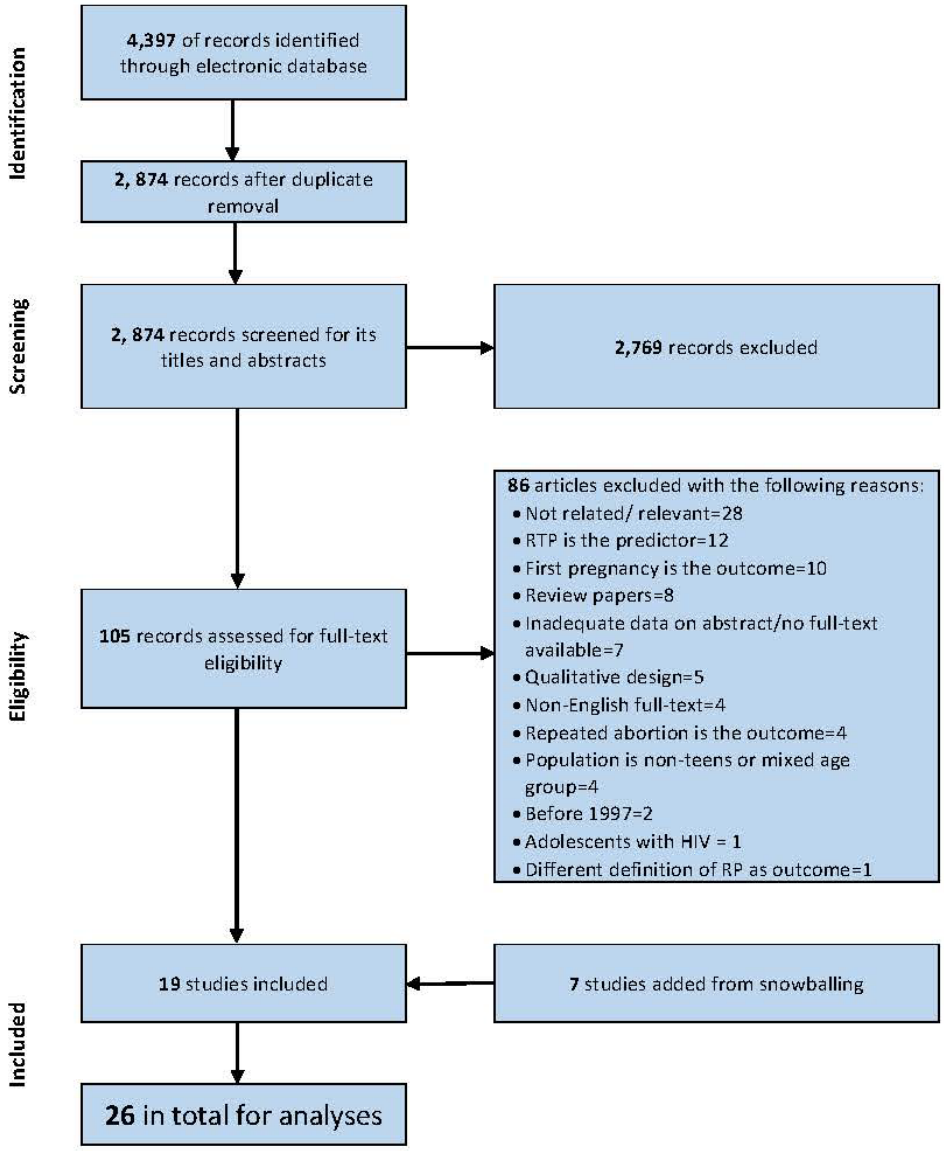

Figure 6.1. 1. Study selection

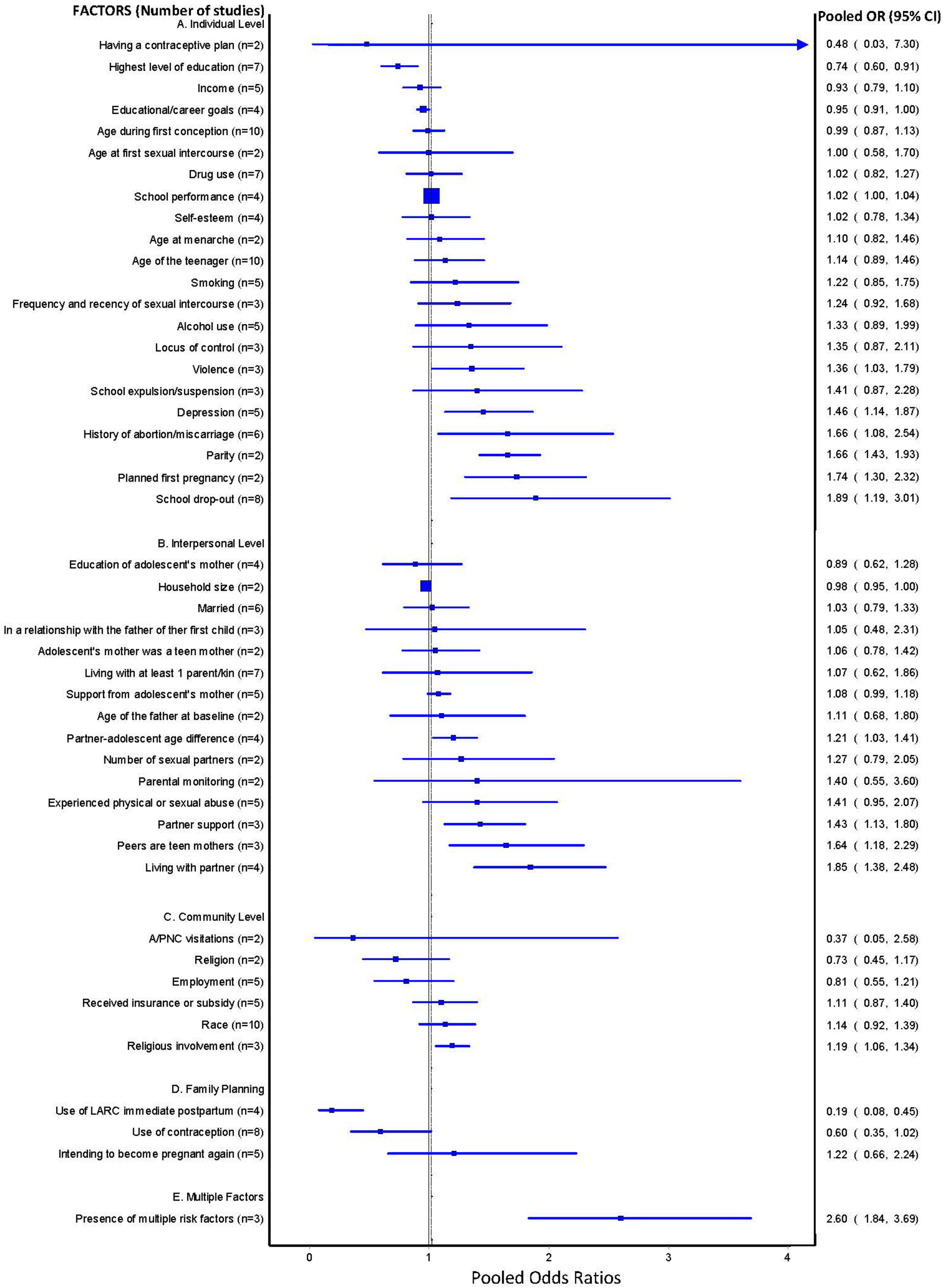

Figure 6.1. 2. Meta-analyses of factors of repeated teenage pregnancies and births (A total of 47 factors were arranged from risk factors to protective factors using socio-ecologic framework

The rectangles represents the pooled odds ratio of each factor while the horizontal line represents its respective 95% confidence interval. The x-axis of the forest plot labelled as pooled odds ratios.)

6.2 Risks of repeated adolescent pregnancy in the Philippines

Manuscript and formal citation

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Supplementary materials in support of this paper appear in Appendix 5 of this thesis.

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Title:

Exploring the risks of repeated pregnancy among adolescents and young women in the Philippines

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Abstract

Objective: Knowledge of the factors which influence repeat pregnancy can inform much needed evidence-based prevention programs. This study aims to identify correlates of repeat pregnancy in the Philippines.

Methods: We used data from five Philippine Demographic and Health Surveys (1993-2013). A total of 4757 women 15-24 years old who had experienced ≥1 pregnancy were included. Individual and partner-related factors were fitted into a series of logistic regression stepwise models with deformalized survey weights. Stratified analyses using two age groups (15-19, 20-24) were also conducted. Interaction terms were included to test for statistical differences between the groups.

Results: Lower wealth quintiles [Odds Ratio (OR)=1.71, 95% Confidence Interval (CI)=1.17-2.49] and partner characteristics such as age of ≥30 years (OR=1.99, CI==1.41-2.82), multiple partners (OR=4.19, CI=1.57-11.19) and live-in status (OR=1.38, CI=1.02-1.87) were found to be highly correlated with repeat pregnancy in fully adjusted analysis. Receiving prenatal care from traditional healers (OR=1.93, CI=1.02-3.63) during the first pregnancy and giving birth for the first time before 18 years of age (OR=1.12, CI=1.04-1.20) showed increased risks among 15-19 years old compared to 20-24 years old in stratified analysis.

Conclusions for practice: In general, partner characteristics were associated with repeat pregnancy among young women suggesting male involvement, especially older partners, in family planning. High risks for repeat pregnancy were observed

among adolescent women who reported younger age at first birth and received prenatal care from a traditional healer which entail promotion of trained prenatal care. Further analysis is needed to validate these findings in other developing countries.

Significance

What is already known on this subject?

- Two existing systematic reviews have been published on this topic, one in 1997 and another from our team inclusive of meta-analysis in 2017.
- We reviewed and meta-analysed 26 epidemiologic articles published between 1997 and 2015, wherein we identified school discontinuation, depression, history of abortion/miscarriage, high partner support, and non-use of long-acting as relevant predictors of repeated pregnancy among adolescent girls
- Despite the breadth of our review, we found a dearth of studies from developing countries.

What this study adds?

- This is the first epidemiological study to report correlates of repeated pregnancy in the Asia-Pacific region.
- Our study adds to the existing evidence by highlighting the risk associated with having older partners among 15-24 year old women, as well as confirming that the use of traditional healers, as main providers of prenatal care and young age at first birth are likely factors of repeat pregnancy amongst teenage women.

Introduction

Early childbearing is a major adolescent reproductive health (ARH) problem in developing countries (Chandra-Mouli, Camacho, & Michaud, 2013; World Health Organization, 2012). This is particularly true for countries such as the Philippines, where a routine demographic and health survey suggests a constant trend from 1973-2013 in adolescent fertility rates with an increasing incidence of early pregnancies (Natividad, 2013; Philippine Statistics Authority & and ICF International, 2014), which is in contrast with improving trends in other developing countries (UNFPA & UNESCO and WHO, 2015). These concerning trends are likely to result in greater unmet needs for family planning amongst adolescents, as well as a greater risk of subsequent pregnancies amongst teenage mothers (Natividad, 2013; Stevens-Simon, Kelly, Singer, & Nelligan, 1998).

The 2012 Philippine Vital Statistics reported that approximately 14% of the 209,274 live births from teenagers were a second birth (Philippine StatisticsAuthority, 2012b), while an epidemiological analysis of repeated pregnancies in the Philippines showed a prevalence of 18% among non-nulliparous teenagers (Maravilla, Betts, & Alati, 2018).

Repeated pregnancies during the teenage years may cause increased burdens on physiological and psychosocial health, ranging from pregnancy complications, psychological distress as well as financial dependency due to the inability to complete school education (Farber, 2009; Gavin et al., 2013; Ownbey, Ownbey, & Cullen, 2011). The extensive impact of repeat pregnancy on adolescents' wellbeing therefore may require urgent planning and implementation of pregnancy prevention programs targeting key factors associated with repeat pregnancy. A meta-analytic review undertaken by our team (2017) identified a number of individual, interpersonal and social predictors from 26 epidemiological studies from 1997-2015. We found that lack of use of contraceptives, school discontinuation, depression, low educational attainment and partner support increased risks for repeat pregnancy by almost two fold. Despite the review's comprehensive and statistically robust results, we were unable to include evidence from developing countries, especially from the Asia-Pacific region, which means that our review recommendations are only relevant to developed countries, where repeat pregnancy prevention programs have been in place for a number of years.

A recent study in a metropolitan area of the Philippines addressing repeat pregnancy among young women reported different sexual, familial and social predictors of number of living children in a cohort of women aged 25 (Gipson & Hicks, 2017). This longitudinal analysis found that poor communication between young women and their mothers, as well as mothers' conservative attitude towards sex during the teenage years strongly predicted having at least two children. While this study investigated a broad range of exposure variables, the outcome of interest (number of living children) was not measured during the teenage years.

Occurrence of repeat pregnancy in teenagers may be associated with a different set of factors because of biological, psychosocial and familial characteristics of teenage mothers. For example, women in their mid-twenties may transition from wanting to prevent pregnancy to wanting pregnancy (Gipson & Hicks, 2017; Miller, 1986) resulting in higher fertility. Moreover, being underage presents additional challenges as parental consent may be required before underage women are allowed to use contraception. Finally, measuring number of pregnancies instead of number of children can provide a clearer picture of repeat conceptions since the former would measure miscarriages and abortions, which are more prevalent amongst teenagers.

Hence, an investigation of developing country-level estimates is necessary to address gaps in the available evidence and provide evidence-based recommendations for ARH policy and programs focused at adolescent mothers other than nulliparous adolescents. Using nationally representative surveys spanning two decades, this study aims to identify correlates of repeated pregnancy in the Philippines at individual, dyadic and societal levels. Also, we compare identified risk factors among teenagers and young adults to address differences amongst these two groups. This will not only contribute to a greater understanding of repeat adolescent pregnancy in the Philippines but also provide knowledge for other developing countries with similar adolescent demographics and cultural dynamics, into the relevant factors that influence repeat pregnancy.

Methods

Sample and Population

We used five datasets (i.e. 1993, 1998, 2003, 2008, and 2013) from the Philippine Demographic and Health Survey (DHS). The Philippine DHS is a routine cross-sectional survey conducted every five years and designed to assess a range of millennium development goal indicators. All the surveys were designed with multi-stage sampling down to the household level, stratified by 17 regions, and rural and urban areas. All women and their children in the selected households were interviewed. A total of 65,261 households were included from the 1993 to 2013 surveys consisting of 72,394 women aged 15-49 years with 14,716 adolescents aged 15-19 years and 26,809 women aged 15-24 years. Less than 2% non-response rates were obtained in all surveys (National Statistics Office-Philippines, 1993, 2003, 2008; National Statistics Office-Philippines & and Department of Health-Philippines, 1999; Philippine Statistics Authority & and ICF International, 2014).

We selected respondents aged 15-24 years who reported experiencing at least one pregnancy. Currently pregnant primigravid respondents were excluded since they were not yet at risk of having repeat pregnancy. In total, 4,757 (7.29% of the original sample) 15-24 years old women experiencing at least 1 pregnancy were included consisting of 912 (19.17%) 15-19 years old and 3,845 (80.83%) 20-24 years old. Eligible women were interviewed by trained interviewers using a pre-tested and expert-validated questionnaire to determine their socio-demographic characteristics, reproductive health, marital status and child health status.

Measures

Repeated pregnancy. Using the self-reported pregnancy history, we created a binary outcome variable defined as an experience of at least two pregnancies regardless of the outcome of the previous pregnancy. The absence of the outcome means an experience of only one pregnancy and not being nulligravid.

First pregnancy experience. These included prenatal visits, intention and outcome of the first pregnancy. We defined prenatal visits using two indicator variables: the provider of the prenatal check-up and the number of antenatal visits. Provider of the prenatal check-up could be either a health professional (i.e. midwife, nurse, and physician) or a traditional birth attendant/healer. Number of antenatal visits was categorized into less than four or more than four. Intention and outcome of the first pregnancy were also dichotomized into intended or unintended, and livebirth or abortion/miscarriage respectively.

Socio-economic status (SES). SES comprised of education, household characteristics and religious affiliation. Educational attainment was categorized as completion /non-completion of secondary education. We collapsed wealth quintiles into three categories (i.e. income class): lower, middle and upper. Household size was also categorical by identifying if the household has the average household size in the Philippines or not (Authority, 2012a). Religion was categorized as Catholic, Muslim or neither.

Demographic characteristics. The current age of the respondents was centered at 18 years and squared, as was the age at first birth, in the final analysis.

The geographical characteristics included region and the type of residence. Instead of the main 17 regions, we used the three main island groups: Luzon, Visayas and Mindanao. The type of residence was categorized as rural or urban. The survey year was used as a continuous variable because of the equal interval between two consecutive surveys.

Use of contraception. This referred to current use of modern contraception. It excluded folkloric and traditional family planning methods. Modern type of contraception included contraceptive pills, condoms, subdermal implants, IUDs, lactational amenorrhea method, sterilization, standard-days method, basal body temperature method and symptothermal method. We were unable to conduct separate analyses for each contraceptive method, because of the small sample size and lack of statistical power. Further disaggregation (long acting reversible, hormonal, barrier, permanent) would have given rise to analytical errors due to insufficient statistical power

Partner characteristics. Partner-related variables included age, education, living status and number of intimate partners. Age was categorized into four groups: "15-19", "20-24", "25-29", and "≥30". Educational attainment of the most recent partner was categorized as completion/ not completion of secondary education. Living status measured whether the respondent currently lived with her partner/husband in the same household. Number of intimate partners was also measured.

Data Analysis

We used the deformalized survey weights which were derived from the sample weights and the recent census of 15-19 and 20-24 years old. Initially, we conducted chi-square analysis and ANOVA to test bivariate associations while using the weighted proportion in each of the measures.

Univariate and multivariate logistic regression models were fitted using a stepwise modelling approach with a 0.20 p-value cut-off. We progressively added into the model SES (Step 1), first pregnancy characteristics (Step 2), and partner-related (Step 3/Final Model) characteristics, while adjusting all the models for use of contraception, geographical characteristics, survey year and religion. Finally we stratified the final model by age to observe any modifications in effect estimates. Age categories were divided into two groups (15 to 19 and 20 to 24); the 15 to 19 year old group included mother who had their first and second pregnancy during teenage years while the 20 to 24 year old group included women who had their first two pregnancies either during teenage or young adult years. Interaction test between age and each correlate was conducted to empirically test age differences in effect size. Akaike's and Schwarz's Bayesian information criteria were used to determine the goodness of fit of the final model by comparing the final model with the previous models. We conducted a sensitivity analysis using three age categories, 15-18, 19-21 and 22-24, to explore difference with women who were below the legal age of consent (i.e. 18 years old).

Results

Sample characteristics

Most of the respondents were from the Luzon region (n=2388; 50.20%) and were living in households with lower income class (2386; 50.15%), as shown in Table 6.2. 1. The highest proportion of repeat pregnancy was found in Mindanao and rural communities in terms of demographics. Respondents with poor SES (i.e. lower income class and didn't finish secondary education) showed a weighted prevalence of at least 50%. First pregnancy variables showed ~30% prevalence among those who had their prenatal examination performed by a traditional healer and reported higher number of antenatal visits. High prevalence of repeat pregnancy was also found among those who did not live with their husband (46.77%), had more than one intimate relationships (71.59%), whose partners were ≥30 years old (55.2%), and had the lowest educational attainment (54.67%).

Multivariate analysis

Table 6.2. 2 shows the stepwise logistic regression models. In the fully adjusted model, women in middle and lower income class had repeat pregnancy risks that were 53% and 71% higher compared with those in the upper quintiles. Respondents who had their first birth after 18 years old had decreased repeat pregnancy risk (OR=0.95; CI=0.93-0.97). Household size, employment status and number of ANC visits were dropped during modelling. Partner characteristics remained associated with increased odds of repeat pregnancy occurrence after full adjustment. Young women who reported having had more than one partner were about four times more likely to report a second pregnancy (OR 4.19; CI=1.57-11.19). Associations also remained for cohabitation, partner's lower levels of education and age (≥30 years).

Results did not change substantively after adjustment for adolescent's current age (see Table S. 12).

Stratified analysis

There were no apparent associations between repeat pregnancy and individual factors in stratified analysis (see Table 6.2. 3), except for age of first birth and type of prenatal care provider. Estimates for respondents who had their first birth before 18 years old were elevated when compared to respondents who had their first birth when they were older than 18. Prenatal examination provided by a traditional healer, increased the repeat pregnancy risk by 93% (OR=1.86; CI=1.02-3.63) among women aged 15-19 years. Interaction tests confirmed these differences for age of first birth (β=-0.19; CI=-0.23--0.11; $p<0.001$) and type of prenatal care provider (β=-0.79; CI=-1.58--0.01; $p=0.049$).

Other factors displayed substantial effect sizes but failed to have significant interaction coefficients. Women in the lower income category showed an increased odds of repeat pregnancy among 20-24 year olds. In this age group, having an older partner and cohabitation remained to show increased repeat pregnancy risk with an OR of at least 1.43. A higher number of intimate relationships (OR=7.23; CI=2.47-21.16) led to increased odds bordering on statistical significance (p-value = 0.08) in age interaction tests. We conducted a sensitivity analysis using three age categories, 15-18, 19-21 and 22-24. Although the small numbers in each cells did not allow some associations to reach agreed standards of statistical significance because of lack of statistical power, repeat pregnancy risk estimates for age of first birth, use of traditional healer and partner's age were remarkably similar to those reported in the main analysis (see Table S. 13). There was also a four-fold increased repeat pregnancy risk amongst those who reported a planned first pregnancy.

Discussion

Main findings

In this paper we investigated factors influencing repeat pregnancy among adolescent and young mothers in the Philippines. In the overall sample, low SES, relationship characteristics such as older partners, cohabitation and partners' lower levels of education were linked to increased risk of repeat pregnancy. In stratified analysis, we found that prenatal examination performed by a traditional healer during the first pregnancy put adolescent mothers at higher risk of having another pregnancy.

Interpretation

Male involvement can play an important role in decisions about family planning and contraceptive use. (Bankole & Malarcher, 2010; World Health Organization, 2013) Our analysis identified cohabitation and large age differences between young women and their partners as strongly correlated with greater likelihood of repeat pregnancy, which confirms findings from other longitudinal research (Black et al., 2006; Raneri, 2007). More frequent sexual contact can be expected among women living with their partners (Black et al., 2006) and this can lead to higher risk of subsequent conceptions particularly when the couple or either partners have limited or no knowledge on family planning (de Fátima Rato Padina et al., 2012). Wide age differences may reflect adolescents' reduced autonomy, greater financial dependency on male partners, and/or relative inexperience in handling relationships. There is also evidence that older partners express their support to young mothers by reassuring them they want the pregnancy (Bull & Hogue, 1998). However this may have the unintended result of encouraging plans for a subsequent pregnancy (Boardman, Allsworth, Phipps, & Lapane, 2006).

Compared to trained health professionals, traditional healers tend to provide inaccurate or no advice on family planning (Kabagenyi, Reid, Ntozi, & Atuyambe, 2016). It has been suggested that this may cause misconceptions about the use of modern contraceptives, and/or not build the individual capital and resources much needed to postpone subsequent pregnancies. In contrast, health professionals have a mandate to encourage greater thinking around subsequent conceptions, and evidence shows that prenatal check-ups performed by trained health professionals incorporate advice on future family planning (Dean, Lassi, Imam, & Bhutta, 2014), hence improving access and use of postpartum contraceptives (O. E. Banke-Thomas, A. O. Banke-Thomas, & C. A. Ameh, 2017).

Pregnant adolescents usually consult traditional healers not only because of low cost services and long distance from health facilities but also because of perceived assurance of confidentiality (Biddlecom, Munthali, Singh, & Woog, 2007). Difference in the age effect can be explained by adolescents' low level of education and poor decision-making ability to delay another pregnancy compared to young adults (Oluwasola Eniola Banke-Thomas, Aduragbemi Oluwabusayo Banke-Thomas, & Charles Anawo Ameh, 2017; Reynolds, Emelita, & Heidi, 2006). Providing adolescent-friendly prenatal services (Chandra-Mouli et al., 2013), through positive attitude among service providers could address these concerns. Home visitations have also been found to be an effective by assisting adolescents to develop a contraceptive plan during pregnancy (Corcoran & Pillai, 2007; Sheeder, Tocce, & Stevens-Simon, 2009).

We found that younger age at first birth increased repeat pregnancy risk among adolescents. This finding has also been observed in a cross-sectional study based in a tertiary hospital in Brazil (de Fátima Rato Padina et al., 2012) and a national longitudinal youth survey in the USA (Davis, 2002). Younger age at first birth allows greater amount of time of exposure to repeat pregnancy risk during teenage years, likely school drop-out with consequent higher exposure to repeat pregnancy (Maravilla, Betts, Couto, et al., 2017).

Multiple partners showed null effect among teenagers compared to young adults, with age interaction term that bordered statistical significance. Despite the low prevalence of multiple partners in our sample, this finding is supported by results from USA-based studies with high prevalence of multiple partners (Black et al., 2006; Montgomery, 2010).

Strengths and limitations

This study has several strengths. Firstly it establishes the complexity of repeat pregnancy in the context of a developing country. Our study also used a robust cross-sectional design using 20 years of data allowing us to adjust our country-level estimates for trends of repeat pregnancy and other key determinants of ARH in the past two decades. The five-year gap between surveys enabled us to avoid inclusion of the same age group participants from one survey to the next since all teenagers in one survey would have become young adults in the subsequent survey. Lastly, the DHS has been widely and regularly conducted in over 90 developing countries worldwide which therefore permits capacity to implement future cross-country and regional comparisons.

The study has some limitations. Despite the relevance of our findings, the temporality between the factors we investigated and the occurrence of a second pregnancy could not be established. For partner-related variables, we were not able to ascertain if the adolescents had a partner with such characteristic before or after the repeat pregnancy occurred. Also, the effect of education was not well examined because of the unavailability of data regarding the education of the adolescent between the first and the second pregnancy, however this is a limitation common to other studies (Maravilla, Betts, Couto, et al., 2017). Our cross-sectional data concurrently measured (current) use of contraception and occurrence of repeated pregnancy. This means that use of contraception could have been the result of repeat pregnancy, particularly if repeated pregnancy occurred before the survey. Therefore, we were unable to come up with a robust estimate for modern contraceptive use as a predictor. Longitudinal data is needed to achieve temporal assumption between repeat pregnancy and contraceptive use while reducing the potential effect of recall bias as well as testing possible mediating effects (Maravilla, Betts, & Alati, 2017). We also had reduced statistical power due to our small sample size for some analyses. Using datasets or surveys focused on adolescents may allow increased sample size and more robust correlation and interaction estimates than this study was able to provide.

Repeated pregnancies among young mothers are more likely among those from lower SES, with older partners and cohabiting with their partner. Younger age at first birth and traditional healers as prenatal care providers during first pregnancy increased the repeat pregnancy risk among teenagers compared with older women. Further studies are necessary to confirm these findings using both longitudinal data and replications in other developing countries.

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Table 6.2. 1. Participant characteristics

Characteristics	Repeated Pregnancy Yes n (Wt%)	Repeated Pregnancy No n (Wt%)	Total
Demographics			
Survey year*			
1993	440 (49.89)	442 (50.11)	882
1998	370 (45.45)	444 (54.55)	814
2003	417 (44.6)	518 (55.4)	935
2008	350 (37.15)	592 (62.85)	942
2013	438 (36.99)	746 (63.01)	1,184
Region*			
Luzon	944 (39.53)	1444 (60.47)	2388
Visayas	333 (42.26)	455 (57.74)	788
Mindanao	738 (46.68)	843 (53.32)	1581
Type of residence*			
Urban	831 (39.14)	1292 (60.86)	2123
Rural	1184 (44.95)	1450 (55.05)	2634
Current Age*+	18.87 (1.91)	19.65 (2.13)	
Socio-economic status			
Educational Attainment*			
No education/ Didn’t finish HS	1079 (50.19)	1071 (49.81)	2150
Completed HS	936 (35.9)	1671 (64.1)	2607
Income class*			
Lower	1179 (49.41)	1207 (50.59)	2386
Middle	415 (41.33)	589 (58.67)	1004
Higher	421 (30.80)	946 (69.20)	1367
Employment*			
Unemployed	1517 (43.18)	1996 (56.82)	3513
Employed	490 (40.03)	734 (59.97)	1224
Religion			
Non-Catholic	330 (41.67)	462 (58.33)	792
Catholic	1532 (41.95)	2120 (58.05)	3652
Islam	151 (48.71)	159 (51.29)	310
Household size*			
<6 members	1240 (48.68)	1307 (51.32)	3042
≥6 members	775 (35.07)	1435 (64.93)	1715
Current use of contraception			
None/Non-Modern	1398 (41.93)	1936 (58.07)	3334
Modern	617 (43.36)	806 (56.64)	1423
First pregnancy			
Age of first birth*+	21.06 (2.16)	21.84 (1.82)	
Intention*			
Planned	1172 (39.37)	1805 (60.63)	2977
Unplanned	387 (29.25)	936 (70.75)	1323
Prenatal care provider*			
Traditional healer	183 (29.76)	432 (70.24)	615
Health professional	673 (22.74)	2287 (77.26)	2960
Number of antenatal visits*			
<4	331 (31.83)	709 (68.17)	1040
4+	540 (21.07)	2023 (78.93)	2563
Outcome*$			
Livebirth	1927 (41.27)	2742 (58.73)	4669
Abortion/Miscarriage	88 (100)	0 (0)	88
Partner characteristics			
Partner's age (in years)*			
15-19	29 (20.86)	110 (79.14)	139
20-24	527 (37.48)	879 (62.52)	1406
25-29	627 (49.06)	651 (50.94)	1278

Characteristics	Repeated Pregnancy Yes n (Wt%)	No n (Wt%)	Total
≥30	314 (55.18)	255 (44.82)	569
Educational Attainment*			
No education/ Didn't finish HS	1062 (51.48)	1001 (48.52)	2063
Completed HS	929 (39.3)	1435 (60.7)	2364
Residing with husband*			
Yes	135 (35.53)	245 (64.47)	380
No	1796 (46.77)	2044 (53.23)	3840
Number of intimate relationships*			
1	1928 (44.41)	2413 (55.59)	4341
>1	63 (71.59)	25 (28.41)	88

Legend: n-sample; Wt%-Weighted proportion; *Significant at <0.001; ⁺Mean and standard deviation was used instead of n and Wt%; $Used Fisher Exact Test; HS-High school
All estimates in bold are significant at 0.05 level of error

Table 6.2. 2. Correlates of repeated pregnancy among adolescents and young adults: Stepwise modelling expressed in Odds ratio (95% Confidence Interval)

Correlates	Univariate	Adjusted for Socio-economic status	+ First pregnancy	+ Partner characteristics
Socio-economic status				
Education				
Complete HS	1	1	1	1
No education/Did not finish HS	**1.81 (1.59-2.05)**	**1.40 (1.22-1.61)**	1.10 (0.89-1.36)	1.02 (0.76-1.37)
Income class				
Upper	1	1	1	1
Middle	**1.67 (1.39-2.00)**	**1.55 (1.29-1.86)**	**1.58 (1.19-2.10)**	**1.53 (1.04-2.27)**
Lower	**2.29 (1.96-2.67)**	**1.88 (1.57-2.24)**	**1.94 (1.47-2.54)**	**1.71 (1.17-2.49)**
Household size				
≤5 members	1	1	1	
>5 members	**0.57 (0.50-0.65)**	**0.69 (0.61-0.79)**	0.74 (0.60-1.04)	
Employment status				
Employed	1	1		
Unemployed	1.11 (01.96-1.29)	0.96 (0.83-1.12)		
First pregnancy				
Age of first birth (in years)*	**0.95 (0.94-0.95)**		**0.95 (0.93-0.96)**	**0.95 (0.93-0.97)**
Intention				
Unplanned	1		1	1
Planned	**1.56 (1.34-1.81)**		**1.40 (1.12-1.74)**	1.08 (0.81-1.44)
Prenatal care provider				
Health professional	1		1	1
Traditional healer	**1.57 (1.26-1.96)**		1.16 (0.89-1.51)	0.94 (0.66-1.35)
Number of antenatal visits				
4+	**1**		1	
<4 visits	**1.92 (1.62-2.30)**		0.92 (0.76-1.11)	
Partner characteristics				
Partner's age (in years)				
15-24	1			1
25-29	**1.72 (1.45-2.05)**			**1.52 (1.14-2.03)**
≥30	**2.37 (1.91-2.94)**			**1.99 (1.41-2.82)**
Residing with husband				
Yes	**1.53 (1.19-1.95)**			**1.55 (1.02-2.36)**
Number of intimate relationships				
1	1			1

Correlates	Univariate	Adjusted for Socio-economic status	+ First pregnancy	+ Partner characteristics
>1	**3.38 (2.02-5.66)**			**4.17 (1.57-11.07)**
Educational Attainment				
Completed HS	1			1
No education/Didn't finish HS	**1.65 (1.44-1.90)**			1.29 (0.95-1.74)

Notes: Outcome of pregnancy was dropped due to collinearity. All steps were adjusted for current use of contraception, survey year, type of residence and religion. *Centered at 18 years.
All estimates in bold are significant at 0.05 level of error

Table 6.2. 3. Correlates of repeated pregnancy by age groups (15-19 and 20-24 years old) using fully adjusted model expressed in Odds ratio (95% Confidence Interval)

Correlates	Age groups (in years)		
	15-19	**20-24**	**Interaction term (p-value)**
Socio-economic status			
Educational Attainment			
Completed HS	1	1	
No education/Didn't finish HS	1.41 (0.67-3.00)	1.07 (0.76-1.45)	0.458
Income class			
Upper	1	1	
Middle	2.09 (0.78-5.62)	1.43 (0.94-2.19)	0.443
Lower	0.92 (0.35-3.57)	**1.97 (1.31-2.96)**	0.256
First pregnancy			
Age of first birth (in years)⁺	**1.12 (1.04-1.20)**	**0.93 (0.91-0.95)**	**<0.001**
Intention			
Unplanned	1	1	
Planned	1.62 (0.79-3.34)	0.98 (0.71-1.36)	0.223
Prenatal care provider			
Health professional	1	1	
Traditional healer	**1.93 (1.02-3.63)**	0.74 (0.48-1.14)	**0.049**
Partner characteristics			
Partner's age (in years)			
15-19	1	0.53 (0.16-1.77)	
20-24	0.92 (0.36-2.35)	1	
25-29	1.12 (0.39-3.17)	**1.43 (1.02-2.00)**	0.603*
≥30	2.68 (0.62-11.53)	**1.61 (1.08-2.39)**	0.300*
Residing with husband			
Yes	1.17 (0.38-3.57)	**1.70 (1.07-2.69)**	0.407
Number of intimate relationships			
>1	1.03 (0.15-7.13)	**7.23 (2.47-21.16)**	0.080
Educational Attainment			
Completed HS	1	1	
No education/Didn't finish HS	1.12 (0.30-2.08)	1.36 (0.96-1.92)	0.563

Notes: Outcome of pregnancy was removed due to collinearity. All the steps were adjusted for current use of contraception, survey year, type of residence and religion. Data presented are Odds ratio (95% Confidence Interval).
*Reference group for interaction test is 15-24 years old. ⁺Centered at 18 years.
All estimates in bold are significant at 0.05 level of error

Summary

This chapter identifies relevant factors and correlates of repeated adolescent pregnancy (RP) to understand the complex and unique characteristics of adolescents in the Philippines. I found a risk effect of consulting traditional healers for prenatal care. Also, my analysis highlighted the impact of having an older partner and de-facto status. This association may indicate dependency and loss of agency of adolescents which may affect informed choices to delay another pregnancy. I found a null effect of religion and religiosity which were also confirmed by an analysis using a community-based cohort in the Philippines [116]. These findings are further explained in **Chapter 8**.

In summary, this chapter provided insights to designing future preventive interventions not only in the Philippines contexts but also in other countries with similar socio-cultural characteristics. I identified factors that can be addressed by existing public health programs/strategies such as the community health worker visitations (discussed in detail in **Chapter 7**). I also identified predictors that are not well-explored in developing countries. These included school discontinuation, depression, increased partner support, and peer characteristics, which should be further explored in future research.

Chapter 7: Community health worker deployment as a prevention program

This chapter deals with the socio-cultural complexities of repeated pregnancy in the Philippine context. In **Chapter 6**, I found use of traditional birth attendants and low socio-economic status as barriers to accessing the reproductive health (RH) services needed to reduce RP risks. Risk effects of a large age difference between the adolescents and their partners and de facto status were found influential. Although religion was found not to be associated with RP, my trend analysis in **Chapter 4** suggested religious influences on the development of RH policies and the implementation of RH programs.

The multifaceted environment of adolescent girls in the Philippines only indicates the need for RP preventative interventions that would enable informed and shared choices to delay another pregnancy. A meta-analysis identified a broad range of preventive programs including home visitations, contraceptive services, education programs, incentive provision and parenting sessions which, in general, have been found to reduce RP risk especially in the first two years after adolescents' first pregnancy [54]. A qualitative analysis found that most adolescent girls prefer home visitation compared to other types of interventions as it facilitates access to health services and sustained support [122]. Home visitations, usually by trained community health workers (CHWs), can enable personal interactions with adolescent mothers and improve self-determination and minimise non-compliance to visit health facilities [122].

Community health workers were perceived globally as effective to improve health seeking behaviour by facilitating access to a package of reproductive health and support services [159, 160]. While CHW visitations was regarded as an appropriate strategy for pregnant adolescents in low resource settings such as the Philippines [54, 122], no summative evidence has quantitatively demonstrated its impact. In this chapter, I conducted a meta-analytical review of CHW programs to evaluate its effectiveness in reducing RP occurrence. The findings of this review are shown in *Paper 7.1*.

7.1 The role of community health workers in preventing repeated adolescent pregnancy

Manuscript and formal citation

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Title:

The role of community health workers in preventing adolescent repeat pregnancies and births

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Abstract

Intervention by community health workers (CHWs) is believed to prevent repeated childbearing among teenagers. This review investigated the effectiveness of CHWs in reducing repeated pregnancies and births among adolescents less than 20 years old, two years after the delivery of their first child.

Through electronic database and hand searching, experimental and/or observational studies were screened with their results undergoing systematic review and meta-analyses. Subgroup analyses were performed to further assess how study characteristics affected the pooled estimates and heterogeneity.

A total of 11 eligible articles, from January 1980 to May 2015, were included. Seven studies evaluated repeated births and eight measured repeated pregnancies. Studies showed relevant disparities in terms of selected methodological aspects and program characteristics. Although the majority (n=9) were either of 'strong' or 'moderate' quality, only two out of five finding a significant reduction exhibited a high level of quality as the other three failed to adjust results for confounders. Random-effects modelling revealed an overall 30% decrease in repeated adolescent births (OR=0.70, 0.49-0.99) among CHW-visited areas relative to non-visited sites. On the other hand, no significant association was detected in terms of repeated pregnancies (OR=0.96, CI=0.70-1.28).

Keywords: community health worker; repeated teenage pregnancy; repeated teenage births; teenage pregnancy; adolescent; meta-analysis

Implications and Contribution

This systematic review reveals a consensus among recent study findings that CHW visitation is an effective strategy towards the prevention of repeated adolescent births. However, limited available research, particularly in developing nations suggests the need for more program evaluations assessing efficacy of CHWs, in addition to operational and sustainability issues.

Introduction

Repeated teenage pregnancy continues to undermine the overall well-being of women and children globally, despite the implementation of innovative prevention strategies. Recent estimates show that 25% of adolescents who have already given birth tend to deliver again within two years postpartum (1, 2). The Centres for Disease Control and Prevention (CDC) reported that one in every five teen births in the United States of America (USA) was a repeated birth in 2013 (3). While this was significantly lower than the 2003 rate (2), it remains a considerable challenge for public health. Additional data from Australia also shows a 33% occurrence of rapid-repeat pregnancy (4).

Unlike first-time pregnancy, subsequent pregnancy may result in greater physical, emotional, mental and social burdens among adolescents. Repeat teenage pregnancy is related to the occurrence of antenatal complications such as small for gestational age, low birthweight infants, births defects and sudden infant death syndrome (SIDS) (5), and has been found to triple the risk of stillbirths, preterm delivery and infant mortality (5, 6). Further, teenagers who deliver more than one child exhibit poorer health seeking behaviour, lower educational attainment and poverty (6).

Given these outcomes, several interventions have been developed to prevent repeated teenage pregnancy. Corcoran and Pillai (7) conducted a meta-analysis of secondary pregnancy prevention programs for teenage mothers, which included school-based programs, home visitations, training, and cash assistance programs. Their review of 16 studies revealed a 50% reduction in the odds of repeated pregnancy for at least 19 months after the first pregnancy. They also found that the effects of the programs started to diminish after 31 months, which may still be considered beneficial as it went beyond the 24 month duration for optimal birth spacing.

The World Health Organization (WHO) emphasized the important role of community health worker (CHW) home visitations to the improvement of adolescent reproductive health (8, 9). The WHO last 1989 defined CHW as “any type of health worker who performs functions related to care… but has no professional, paraprofessional or tertiary education” (9). On the other hand, a more recent WHO technical brief noted “CHW is often referred to… volunteer or salaried, professionals or lay health workers…” (8). With this unclear definition, CHW can be regarded either as lay health workers or paraprofessionals performing either a voluntary, compensated or paid community services.

Community health workers may increase access to reproductive health services such as contraceptives (9-11), and provide counselling and health information among hard-to-reach and ‘hidden’ adolescent mothers. Since CHWs and adolescents often come from the same community, sharing a similar social environment enables CHW to easily establish rapport, which facilitates the provision of services in an effective, acceptable and appropriate manner. This helps in resolving the barriers hindering adolescents to openly discuss their problems (12). Multiple controlled trials have shown that adolescent mothers visited by CHWs had significantly lower rates of repeated pregnancies two years after their first delivery (2, 5, 12-16). Black, et al. (2) and Ownbey, et al. (5) found that teen mothers who received at least two visits showed three times reduced risk of conceiving a second child.

Although CHW-based strategies have been recommended and proven in reducing subsequent adolescent pregnancy, Barnet, et al. (17) and El-Kamary, et al. (18)

found no significant decrease in the risk of repeat pregnancy 24 months after the launching of the CHW, while a multi-site evaluation by Kan, et al. (19) found only a short-term effect. Inconsistency in the available evidence requires analyses capable of producing a consensus on the overall impact of CHW while also examining the various factors affecting the success of its implementation. Apart from the usual difference in study design and quality, characteristics of each CHW program especially the services being provided, CHW skills capacity as well as supportive supervision may influence the effectiveness of the intervention and explain heterogeneity among studies.

Despite the previous meta-analysis of Corcoran and Pillai (7) on secondary prevention programs, their results did not include estimates specific to CHW home visits and did not measure separate effect sizes for repeated pregnancies and births. Further, the most recent study they reviewed was published in 2003 suggesting the need for more specific and updated evaluation reports.

In this meta-analytic review, we aim to investigate the impact of CHWs in preventing separately repeated teenage pregnancies and births two years after first delivery and to evaluate how selected program characteristics may have affected the outcome. This addresses specific issues in previous reviews and meta-analyses by specifically looking at CHWs instead of pooling the effects of all prevention programs with more varied characteristics. This study also expands its analyses through disaggregation of the measured outcomes into pregnancy and births, together with extension of subgroup analyses in terms of program characteristics aside from the common methods aspects.

Methods

Search Strategy

This systematic review utilized PubMed, EMBASE, CINAHL, Medline, Web of Science, ScienceDirect, Scopus, PsychINFO, Social Work Abstract and UQ Library, using key terms including community worker, community health worker, home visit, reduce, prevent, repeat, subsequent, teen, pregnancy, birth and childbearing. Identified review papers were utilized to snowball other relevant literatures. The Family Planning and Contraceptive Research bibliographies (20) were also consulted to expand the number of articles screened. Only papers in English language from January 1980 to May 2015 were taken into account, comprising of journal articles and grey literatures. We chose this period since no reviews has yet been conducted in this specific topic.

Screening and Selection

After removing duplicates, titles and abstracts were assessed for relevance using the PRISMA guidelines (21). Selected articles went through further screening. Only observational studies, quasi-experimental, and randomized-controlled trials (RCTs) were included, all of which must have evaluated CHW home visitation program, aiming to reduce the occurrence of repeated pregnancies and/or births within two years after the first pregnancy, among adolescents aged 20 years or younger. Studies which utilized the same dataset were excluded. Erratum and review papers were also not included.

Data Extraction and Quality Assessment

At least two researchers independently extracted characteristics, participant information and results as well as assessed the quality of each study. Inconsistencies were discussed and finalized before analysis. The Quality

Assessment Tool for Quantitative Studies of Effective Public Health Practice Project was used to comprehensively assess the risk of bias of each study (22). The Cochrane Review Group (23) and the Centre for Reviews and Dissemination (24) have both recommended this tool for evaluating the integrity of public health interventions specifically the methodological aspect of each study. Quality assessment was done after data extraction to prevent bias during reporting of the results (25).

Data Analysis

The final articles went through narrative analysis which allowed grouping based on methods, intervention type and result characteristics. Meta-analysis was then conducted to measure the overall impact of CHW to repeated pregnancies (RP) and repeated births (RB) using MetaXL and Stata 13. A random-effects model was applied to estimate the pooled odds ratio (OR) for each outcome (25). Heterogeneity was determined using Cochran's Q at 0.10 error and I^2 statistic, since these are sensitive but have less power in a small number of studies (26). Egger's regression coefficient was calculated to evaluate publication bias.

Subgroup analyses were conducted to further examine how methodological (including quality) and programmatic factors (i.e. type of CHW, type of program, presence of supervisor) affected heterogeneity and the pooled OR. The methodological subgroups included study quality and type of control. Quality subgroups were rated 'weak', 'moderate' and 'strong' based on the outcome of quality assessment. Studies were also divided into two groups depending on the type of control subgroups, 'with intervention control' and 'without intervention control'. Studies 'with intervention control' compared CHW home visiting programs to an existing program (e.g. JOBS, standard programs, usual care). Those 'without intervention control' included studies which did not include any type of intervention. Articles which failed to mention the type of their control were included in this subgroup.

On the other hand, the programmatic set dissected the analysis by type of CHW, type of program, and presence of supervisor categories. Types of CHW included either 'lay health workers' or 'paraprofessionals'. Articles were also grouped by the type of program, if the CHW program was 'supplemental' (added to an existing program) or not. Presence of supervisor was divided into those which had and did not have a CHW supervisor.

Results

Overview of included studies

Out of 557 articles found, only eight studies fully met our inclusion criteria. As shown in Figure 7.1. 1, 383 out of 421 articles without duplicates were removed during title and abstract screening because of non-relevance of the topic, unavailability of the abstract, and being commentaries/editorials. During full-text screening, 30 from the 38 remaining records were excluded mainly because of different home visiting intervention, being a review or erratum papers, and measurement of other outcome variables. An additional three studies were identified from six review papers, resulting in a total of 11 articles for which the majority were published after 2000 (n=7).

Interestingly, all of the studies identified were conducted in the USA. Each CHW program identified was conducted in one of the states of the USA (see **Table 7.1. 1**). Some programs undertook a multiple site implementation which included two or more states, and all CHW programs targeted communities with lower socio-economic status and high teenage pregnancy rates. Six studies involved lay health workers while the remaining five articles recruited paraprofessionals as CHWs.

CHW programs and evaluation

Every program aimed to establish relationship with pregnant adolescents and/ or teen mothers. Home visitations were performed regularly to engage with the individual situations of the teenagers. Each CHW was assigned with 10-15 adolescents and was deployed in the third trimester of pregnancy, or after birth when their first child was at most three months old. Programs required CHWs to conduct several home visits, with frequency ranging from 1-2 times weekly to 2-4 times monthly. Five programs delivered this intervention until the second birthday of the first child, two home visitations lasted for six months, whereas the remaining programs failed to mention the length of their intervention.

Five programs recruited their health workers, who were educated to at least a high school graduate level, with experience in outreach activities, and had a positive attitude towards family planning. CHWs residing in or near their target communities were preferred. All recruited CHWs were trained and expected to facilitate communication and interaction with the adolescents especially on sensitive issues. Two studies did not provide information on the eligibility criteria of their CHWs.

Home visitations of CHWs revolved on issues around adolescent reproductive health and child development. This included family planning and awareness of contraception, safe sexual practices, and other available health services were discussed to motivate adolescents to avoid another pregnancy. CHWs provided information on parenting skills, infant stimulation and child development; they encouraged teens to continue and complete their education and helped develop their coping skills in addressing personal and interpersonal problems. CHWs were also involved in the joint development of life goals and individualized plans.

Some CHW programs served as a supplement to an existing intervention. Kelsey (27) enhanced its JOBS program, an employment and cash assistance program, with the incorporation of CHW home visitations. Furthermore, Kan, et al. (19) evaluated CHW effectiveness in addition to the 10 basic services of the Adolescent Life Program.

Most studies employed either a randomized-control trial (n=5) or a quasi-experimental design (n=4), while the multiple site evaluation by Kan, et al. (19) considered both design types. Only the Sangalang, et al. (16) used a retrospective cohort design. It was observed that more than 50% (n=6) of the articles used a comparator intervention as the control. The five remaining studies stipulated a “no intervention control”.

Table 7.1. 2 shows that adolescents were typically recruited from healthcare institutions (i.e. hospitals, clinics), community centres and/or referral from existing programs. Sample characteristics taken during the second year of evaluation showed that participants were mostly African-Americans, mostly attending 9th or 10th grade of high school. Nearly half of the studies (n=5) included 60-100 adolescents while a third (n=3) comprised of 600-800. Sangalang, et al. (16) analysed more than 2,500 participants. All followed their participants for two years or until the second birthday of the first child. Retention rates at the end of the second year follow-up ranged from 26.3% to 94.8% because of loss of follow-up and refusal to continue the program. Two studies (14, 16) failed to report their retention rates.

Results of studies

Outcome measures included RP and/or RB outcomes during the 24 month follow-up. Four out of 11 considered both measures, while the remaining studies focused either on RP (n=4) or RB (n=3) alone. Five found a significant effect in the reduction of RP and RB in the intervention group. Sangalang, et al. (16) selectively reported findings in the 12-16 age group as those in the 17-19 age group did not show significant results. Studies which concluded on an absence of CHW impact (n=6) attributed the non-significant result to the lack of confidence of CHWs, inadequate theoretical context of the program and the presence of a comparator receiving another set of interventions. Three program evaluations which showed an increase in the odds of RP or RB did not provide further interpretation of these findings.

Quality assessment results

Six studies were rated as ‘moderate’ quality, while others either showed strong (n=3) or weak (n=2) quality (see Figure S. 2). Of the five studies with significant results, only two exhibited rigor in all components of their methodology. The remaining three studies had moderate (n=2) and weak (n=1) quality as they failed to adjust their effect estimates for confounders.

Kelsey (27), Sims and Luster (28), and Ownbey, et al. (5) used CHW supervisors/ coordinators to coach and monitor the home visitors to ensure consistent function and interaction of CHWs with their assigned adolescents. However, the evaluation of intervention integrity exposed the under reporting of consistency of intervention implementation in most studies. Risk of contamination was found present among the control groups due to area proximity between the two groups. Contamination may lead to difficulty in the detection of program impact as the controls tend to receive interventions from the program through other channels (i.e. relatives, friends).

Results from the meta-analysis

The random effects analysis of 8 studies (2,651 adolescents) showed a non-significant 4% reduction in the odds of having a RP (OR=0.96; CI=0.70-1.28; Figure 7.1. 2). Significant low levels of heterogeneity were also noted (Q=13.49, p=0.06, I^2=48%). Results from the quality subgroup analysis (as shown in Table 7.1. 3) revealed pooled OR and heterogeneity in the moderate subgroup similar to the overall OR. Studies without an intervention control demonstrated a significant OR of 0.31 (CI: 0.10-1.00) and an absence of heterogeneity. The remaining categories of quality and their respective subgroups still showed non-significant ORs and varying levels of significant heterogeneity.

A 30% (OR=0.70, 0.49-0.99; asymptotic z=-2.001, p=0.045) overall decrease in the odds of RB was found. The 7 studies (3,635 adolescents) included in this meta-analysis showed a significant heterogeneity of moderate magnitude. There was a significant reduction of RB among moderate (OR 0.69, 0.49-0.97) and strong (0.73, 0.57-0.95) quality subgroups. Heterogeneity in these subgroups was found negligible with an I^2=0 and Q p-value of particularly above the 10% margin. Conversely, those in the weak subgroup indicated a non-significant OR. 'Without intervention control' subgroup depicted a substantial decrease in odds (OR=0.48, 0.23-0.97) of RB. It can be seen that this was also observed in analysis of RP. The small number of studies in this subgroup, however, meant the pooled effect size was not as robust.

Lay health worker subgroup showed a significant pooled OR of 0.69 (0.49-0.97). Moreover, 4 very homogenous (Q=1.85, p=0.6, I^2=0) studies without a CHW supervisor had a more precise estimate (0.71, 0.58-0.88). The non-supplemental subgroup, which contained all but the study by Kelsey (27), revealed that CHW reduced RP by almost 40% odds (OR=0.63, 0.48-0.84) with non-significant heterogeneity.

Sensitivity analyses (refer to Table S. 14) among studies with RP outcome showed minimal changes in its pooled estimate. Although exclusion of the multisite evaluation by Kan, et al. (19) reduced pooled OR from 0.96 to 0.87, this estimate is still not statistically significant. On the other hand, removing Kelsey (27) in the meta-analysis of RB resulted in a more precise pooled OR while further reducing the risk of RB from 0.70 (0.49-0.99) to 0.63 (0.48-0.84). Meta-analyses of both outcomes displayed absence of publication bias with a coefficient of -1.37 both for RP (p=0.18) and RB (p=0.35).

Discussion

Our systematic review and meta-analysis found that CHWs' involvement with adolescents led to a 30% reduction in the risk of RB among teenagers two years after their first pregnancy while no significant reduction was found regarding RP. Studies looking into RP had more diverse (increasing and decreasing) and non-significant ORs than studies of RB.

Community health workers in adolescent reproductive health

Recent evidence and policies recommend the deployment of CHW as an effective intervention to improve not only adolescent reproductive health but also a broader range of maternal-child health outcomes, with some of the strongest evidence contributed by a recent RCT which found a clinically significant delay of subsequent adolescent live births (12). This CHW program provided comprehensive social and family planning support, promoted prevention of another pregnancy and encouraged adolescents towards health seeking behaviour. A comprehensive systematic review of 82 studies depicted CHW as an effective intervention to improve child immunization and nutrition (29). CHW lessens the burden of health professionals in reaching out to households in remote areas (8, 30).

The crises arising from adolescent pregnancy and parenting may disrupt normal life processes and lead to loss of personal goals. The reengagement of which requires motivational interventions with individually tailored counselling and emphasis on attainment of life ambitions and autonomy. CHWs can provide these services and deliver related outcomes beyond the caregiver-patient relationship. CHWs can assume a supportive role (10) designed to create a sustainable relationship and motivate adolescents to pursue their life goals (6).

Programmatic and methodologic issues

Despite the positive influence of CHWs, some programs were not able to attain the intended outcomes. This current review found that non-effective programs needed more concrete promotion strategies directly targeting secondary pregnancies rather than a broader approach (17, 19, 27, 31). A strong contextual basis may play a role in the achievement of CHW program objectives (5, 17, 27). An appraisal of CHW training manuals revealed an absence of clear instructions on how to communicate fertility-related issues and subsequent births prevention strategies (18). Various evaluations have suggested the need to anchor activities within tangible concepts such as socio-cognitive frameworks, developmental theory and resilience models (2, 11, 32, 33).

Failure of CHW programs has been also related to the absence of supportive supervision and monitoring (8, 29, 34). However, findings from this review suggest these issues may not be as relevant as previously anticipated. CHWs without ongoing supervision effectively lowered RB and RP, suggesting that the presence of a supervisor doesn’t guarantee effective CHW management, but rather depends on the functions performed by the supervisors. Supervisory support given in the studies often focused on data collection rather than performance evaluation and feedback (34). Furthermore, expanding the scope of a teen mothers program did not show the expected improvement. Evaluation of CHW as a supplemental intervention tended to be less effective. Being an auxiliary program may increase burden and set impractical expectations among CHWs. Establishing too high expectation may also lead to an unsuccessful CHW program (8, 29). The original program with which the CHW program was supplemented may also reduce the effectiveness of the CHW program in cases where the original program itself is known not to be effective.

Methodological issues such as weak study design, high attrition rate and poor sampling techniques, may have also affected findings (5, 18), and we found that quality greatly influenced the pooled results. ‘Moderate’ and ‘strong’ quality subgroups exhibited a significant reduction of RB in addition to a negligible level of heterogeneity. A significant adjustment of pooled OR and narrowing of CIs were also observed after separation of low quality studies.

Evaluation of CHW programs were also at risk for intervention inconsistency and contamination. Selected studies utilized control sites which were adjacent to the CHW sites. With the absence of effective program monitoring, it was not determined whether adolescents in the control group unintendedly received CHW home visits; and if all the adolescents in the treatment group received the same number of visitations. Presence of contamination may under estimate the true effect of the intervention (35). Although some studies used clustered randomization to avoid this (35, 36), no measure was used to ensure intervention integrity until the last year of follow-up.

Limitations

Although this review aimed to include programs from different countries, database searches only found USA-based programs; meaning, the findings offer only limited insight to the potential of success should similar programs be implemented in low and middle income countries (LMICs). Although the selection of lower socio-economic communities in the USA may somewhat extend the generalisability of our findings to LMICs (29), there are still other factors (i.e. health systems, policy approaches) which are likely to confound the program dynamics.

Subgroup analyses diminished the magnitude of heterogeneity among each subgroup, clearly showing factors which might influence effectiveness of CHWs.

However, subgrouping further reduces the number of studies decreasing the robustness of estimates in each subgroup. Formulating broad views must be done with caution because of varying levels of heterogeneity and the small set of studies. Similar to other comprehensive program reviews (7, 29), unavailability of other program information restricted the intervention typologies in meta-analysis which may include frequency and duration of CHW home visits, caseloads or CHW to client ratio, adequacy of incentives and other variables which might impact effectiveness and sustainability.

Implications and future research

Community health workers was found effective to reduce the occurrence of repeated births among adolescents especially in low-income communities. Despite of this finding, this review was limited to studies conducted in USA. While recent programs have started to focus on specific interventions in community health (29), the 2015 WHO guidelines for CHW implementation still doesn't reflect specific strategies for adolescents and adolescent mothers (8). Mapping of CHW training resources also highlighted that no published materials are dedicated to adolescent and reproductive health and sexuality because of the inability of CHW to effectively address sensitive and stigmatizing issues (34).

These therefore demand development and evaluation of CHW programs in LMICs which may have greater risk for repeated adolescent pregnancy. The WHO similarly suggested that further research is necessary to assess feasibility and effectiveness of social support interventions and contraceptive program to reduce repeated teenage pregnancy in developing countries (10). Instead of RCT, observational studies may be performed as an alternative method of measuring the effect of CHW exposure. Aside from childbearing outcomes, programmatic issues, such as operations and sustainability must also be considered to obtain a complete picture of the program.

Comparative analysis between lay and paraprofessional CHWs, aimed at dissecting the good practices which may differ between the two groups, can be undertaken to improve each type of home visitor. However, the studies included in this review did not adequately define their CHWs (i.e., paraprofessional or lay). Future studies should include a clearer definition to make such analyses possible.

Evaluation of the 11 studies highlighted a number of points by which CHW programs may be improved. Polit and Kahn (37) emphasized that long-term impact should not be expected out of short-term CHW home visits. Deep and sustained relationship (38) aside from health promotion and counselling at home can help in delaying another pregnancy among adolescents. It has been suggested that continuous interaction and family planning advice 24 months after the first pregnancy is one of the essential components of strong social support (39). Involvement of males or teenage fathers is also an effective strategy for CHWs. As teenage fathers separate themselves because of confusion with regards to their role as a provider (39), addressing their emotional needs may facilitate mutual decision towards parenting and prevention of repeated pregnancy.

Home visitations of CHWs was found to be an effective intervention towards the prevention of subsequent childbearing among adolescents. However, the limited available evidence, especially in LMICs, stresses the need for the development of CHWs aimed at reducing RP and RB outcomes. Further investigations as well as program modifications are necessary to establish more reliable context concerning CHW potential on the promotion of adolescent reproductive health.

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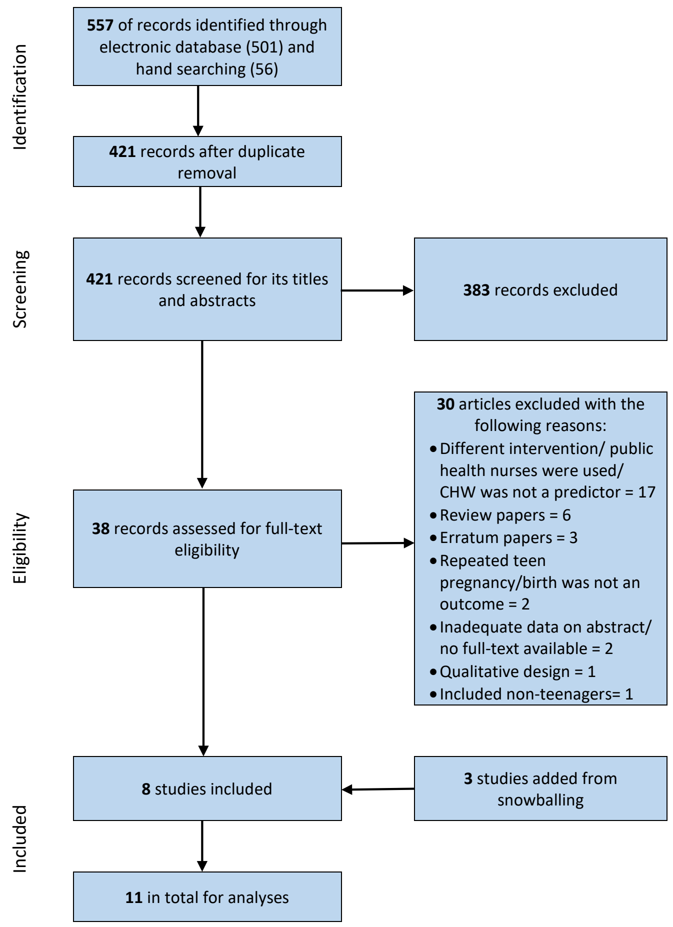

Figure 7.1. 1. Search strategy flow diagram

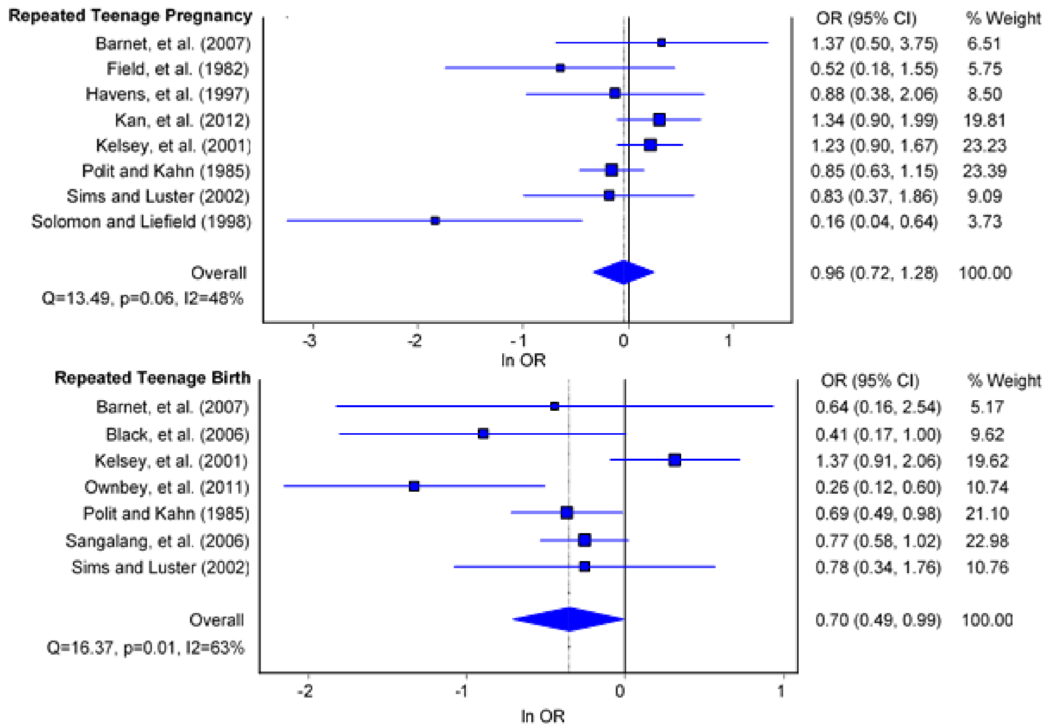

Figure 7.1. 2. CHW towards repeated teenage pregnancies and births: Random-effects meta-analysis

Table 7.1. 1. CHW home visitation program description, CHW eligibility and length of intervention

Study	Program and Setting	Program Description	Eligibility of CHWs	Length of Intervention
Barnet, et al. (2007)(17)	Home visiting program Economically disadvantaged areas in Maryland, USA	Each home visitor was trained to individually deliver parenting and adolescent curricula to 10-15 adolescents. These include child development, safe sexual practices, prevention of repeat pregnancy, violence, school engagement and healthy relationships.	• High school degree • Experience related to healthcare, child development or social work • Good interpersonal skills	At least 2 visits per week from 3rd trimester of first pregnancy until first birthday of the infant and at least once until the second birthday.
Black, et al. (2006)(2)	Big Sisters Home visiting program Low income communities in Maryland, USA	Each of the "Big Sisters" were visiting approximately 15 mothers. They discussed about "mother-daughter" relationship, personal values, decision-making for subsequent pregnancies, access to birth control, as well as goal setting. They also provided condoms every point of contact with the adolescent.	• College educated • African-American • Single mother • Living independently • Raising 1 preschool child	At least twice a month until the first birthday of the first child
Field, et al. (1982)(14)	Parent training program Low income community in Florida, USA	Home visitors trained the adolescent mothers about infant simulation, care taking and mother-infant interaction exercises.	• Psychology graduate • Trained with Comprehensive Employment Training Act	At least 2 visits a week for 6 months
Havens, et al. (1997)(27)	Milwaukee Collaborative Teenage Pregnancy Prevention Program Wisconsin, USA	This mentoring program allowed the home visitors/ mentors to build a relationship with a teenager and discuss with them health and contraception, continuing education, parenting and budgeting. They also helped teens to cope with some of their personal problems. Each mentor was assigned with 15 teens in average.	• Good experience with dealing adolescents • Considerable knowledge on community resources • Positive birth control attitude	At least 12 hours per month interacting with adolescents for 2 years
Kan, et al. (2012)(19)	Adolescent Family Life Program Multiple sites within USA	In addition to the 10 core services of the Adolescent Family Life Program, adolescents received home visits to deliver at hand counselling, preventive maternal services, nutrition, sexual health, paediatric care, coping, family planning and mental health information. Aside from home visits, the program also conducted school-based activities to 29% of its project sites.	• Not mentioned	At least once every 2 weeks for 2 years
Kelsey, et al. (2001)(28)	Inclusion of Home visitor services with Job Opportunities and Basic Skills Training Program (JOBS) Chicago, Ohio and Oregon, USA	Home visitor services was supplemented to JOBS in increasing the attainment of its outcomes. Home visitors or paraprofessionals had frequent interaction with their assigned teens to enable a more intimate relationship with them. They are teaching parenting skills, effective family planning, and community resources for health care. They also referred women who need immediate care.	• Don't have specific professional training on program key areas • Have desirable attributes to facilitate access to adolescent health services	From 45 minutes to 1 hour every week for at least 24 months
Ownbey, et al. (2011)(5)	Healthy Families Home Visitation	Family Support Workers (FSW) which has a caseload of 15-20 adolescents each. FSW facilitated development of Individual	• Non-degreed (High school, college	From 6 months to 5 years

Study	Program and Setting	Program Description	Eligibility of CHWs	Length of Intervention
	Program North Carolina, USA	Family Service Plan, built a strong trusting relationship with their teen as well as emphasized education, child development, parenting and access to community resources.	undergraduate) • Able to address sensitive issues to adolescents	
Polit and Kahn (1985)(29)	Project Redirection Multiple sites within USA	Community women were utilized to support adolescents towards their personal goals in form of individualized participant plan. Aside from home visiting, peer group session were also done to assist adolescents with their social and personal problems	• Residing in the project site	Not mentioned
Sangalang, et al. (2006)(16)	Adolescent Parenting Program North Carolina, USA	Each home visitor was assigned to 12-20 first-time pregnant or parent adolescents. Their goal is to help adolescents develop their personal goals, provide case management and conduct individual counselling. They motivated teens to avoid secondary pregnancy, continuous participation, practice good reproductive health.	• Either graduate of social work, psychology or sociology	From 3 to 4 times a month for 18 months
Sims and Luster (2002)(30)	Family Support Program Michigan, USA	This intensive program provided home visitations of family advocates. They gave information about the community services and care for their children, delivered emotional support and encouraged mothers to pursue their life goals and finish education. They also accompanied teenagers to access service in the community and help them filling-out necessary health facility forms for non-literate mothers. Each advocates were assigned with 12 adolescents	• Not mentioned	Not mentioned
Solomon and Liefield (1998)(31)	Family Growth Centre Poor urban neighbourhood in Pennsylvania, USA	FGC has social workers and prenatal counsellors recruited from the project sites. They provided social support, crisis intervention, and parenting support services to their assigned clients. These home visitors also conducted bimonthly parenting classes. Ecological approach (context of family and neighbourhood) was followed.	• Respected older indigenous woman • From the community where they are assigned	Until 6 months after delivery of the first infant of the adolescent

Table 7.1. 2. Study design, follow-up, results and quality

Study	Sample (During 2nd year evaluation)	Design, Follow-up period and Retention rate	Key Findings	Significant Confounders	Quality Rating
Barnet, et al. (2007)(17)	**63** pregnant adolescents aged 12-18 years (mean age=16.9) whose pregnancies were of at least 24 weeks of gestation recruited from 3 urban University of Maryland affiliated prenatal care sites. Most of them were African-Americans.	**Random assignment** of adolescent to intervention and comparison (usual care) groups. Evaluators were blinded during data collection. *Follow-up: 1 and 2 years* *Retention rate: 51.6%*	*Outcomes measured: Adjusted Odds Ratio (AOR) of RP and RB* Evaluation showed no significant improvement on RP (AOR=1.2, 0.4-3.5, p=0.69) and RB (AOR=0.6, 0.2-2.6, p=0.54) 2 years since the program started. It was explained that the program lacked motivation approaches to obtain “sustainable decision” to limit conception.	• Frequent use of condoms in the past 12 months (AOR=3.6) • In school or graduated at year 2 (AOR=3.5)	Moderate
Black, et al. (2006)(2)	**149** low-income, adolescent mothers who were currently residing with their mother, at most 18 years of age (mean age=16.3), African-Americans, and had no indication of heroin, cocaine, and chronic illness which would interfere parenting or adolescent development. Participants were predominantly on their 10th grade and of good relationship with the father of their child (70%).	**Randomization** was done to assign adolescents to treatment and control (no further contact until evaluation visits). *Follow-up: 6 months, 13 months and 24 months* *Retention rate: 82.3%*	*Outcomes measured: AOR of RB* Analyses revealed that adolescent mothers in the control group gas 2.45 (1.003-6.03, p<0.05) more odds to have RB than those in the home visited groups during 2nd year assessment. Although only 40% received more than 8 visits, those with at least 2 visits still had 3x less the risk of RB.	• None	Strong
Field, et al. (1982)(14)	**61** black teenage mothers aged 13-19 years (mean age=16.3) from low income households were recruited from a large university	Participants were **randomly assigned** to program and comparison or no-intervention groups *Follow-up: 4 months, 8 months, 1 year and 2 years*	*Outcomes measured: Proportion of RP* During the 2-year assessments, occurrence of repeat teen pregnancy in the intervention group (27%) was significantly lower than the control (39%) with a p-value <0.05. Despite of the	• Confounders were not considered during analysis.	Moderate

Study	Sample (During 2nd year evaluation)	Design, Follow-up period and Retention rate	Key Findings	Significant Confounders	Quality Rating
	neonatal hospital. Only those without perinatal complications were included.		program's focus on infant, it had a "hidden benefit" to prevent further pregnancy among teen mothers. One-year assessment also revealed same pattern (9% versus 19%, p<0.05).		
Havens, et al. (1997)(27)	**98** unmarried teenagers, with an age ranging from 12-19 years (mean age 16.5), during her 3rd trimester of her first pregnancy were included from community hospitals, schools, health centres and private clinics. Large proportion are African-Americans.	**Randomization** was employed to allocate adolescents to treatment and control (receiving assistance only from community agencies and family/friends). *Follow-up: 6, 12, 18 and 24 months postpartum* *Retention rate: 89.1%*	*Outcomes measured: Proportion of RP* The program has no significant impact on repeat pregnancy after 2 years of implementation. Mentoring group had 66% while the control had 68.8%. In each group, there was almost same proportion with 1 RP (40%), 2 RP (23%-24%), and 4 RP (2%-5%). It was suggested the high rates of RP in the mentoring group was due to the program failure to address sexual health issues. CHW only tackled education and relationship issues instead of more sensitive topics.	• Confounders were not considered during analysis.	Moderate
Kan, et al. (2012)(19)	**794** adolescents aged 12-19 years (mean age=17) and able to read English or Spanish. About 50% was African-American while most from comparison groups was older and had higher educational attainment.	This multiple-site evaluation performed **either randomization or not** depending on the project area. The comparison group received the 10 core services of the project without home visitation. *Follow-up: within 12 months and after 12 months from baseline* *Retention rate: 54.2%*	*Outcomes measured: AOR of RP* Study showed that the program brought no significant reduction on RP after 24 months (AOR=1.39, 0.84-2.30) unlike during its first year (AOR=0.73, 0.55-0.97). With these, it was concluded that the program only had a short-term impact towards RP. Study did not provide explanation regarding this result.	• Age • Currently pregnant/ parenting • Educational attainment	Moderate
Kelsey, et al. (2001)(28)	**708** childless, pregnant adolescent below 19 years old (mean age=18.2). They must also be approved from Medicaid for their unborn child and currently receiving cash assistance.	Teens were **randomly assigned** to intervention and control groups (only JOBS). JOBS provided monetary incentives to teens but does not directly influence fertility control, lifestyle, housing, parenting, and child care.	*Outcomes measured: Adjusted Impact and Percentage Change of RP and RB* Despite of the program influence on increase condom use and passive contraceptives, there were no observed significant change in RP (Impact 4.8, P=0.20) and RB (Impact=4.3, p=0.12) during the 2nd birthday of	• Age of first child in months	Weak

Study	Sample (During 2nd year evaluation)	Design, Follow-up period and Retention rate	Key Findings	Significant Confounders	Quality Rating
	Almost all are African-American, non-Hispanic, finished 10th grade but currently not enrolled in school.	*Follow-up: 24 and 27 months* *Retention rate: 26.3%*	the first child of the adolescents. There was actually non-significant increase in RP and RB in the home visitor services group than the control (JOBS) with a percentage change of 14% and 31.2% respectively. These results were attributed to the incapacity of the home visitors to address sexual health problems and to provide sensitive family planning information.		
Ownbey, et al. (2011)(5)	**220** pregnant or currently teen parents with an infant under 3 months, aged 13-19 years, with at least late prenatal care compliance or with incidence of abortion or adoption were recruited from healthcare institutions.	This post-intervention measurement only study **did not involve randomization**. Those assigned to control group were not receiving any intervention and those cannot be included due to limited slots. *Follow-up: 24 months* *Retention rate: 94.8%*	*Outcomes measured: Proportion of RB using Chi-square* Healthy families program resulted into a significant positive effects on reduction of RB (X^2=8.87, df=1, p=0.0029).Teen mothers in the treatment group (8.9% versus 26.9%) were 67% less likely to experience another pregnancy 2 years after their first livebirth.	• Confounders were not considered during analysis.	Weak
Polit and Kahn (1985)(29)	**675** adolescents who are 17 years old or younger (mean age=16.4), either pregnant or parent, did not complete high school, from low-income family and either receiving or eligible for welfare assistance included were referrals from community service or word of mouth. 50% were African-American and 60% were currently pregnant during the start of the program.	This study **did not employ randomization** in which the control group received services as a participant of the Office of Adolescent Pregnancy Program. *Follow-up: 12 and 24 months* *Retention rate: 85.6%*	*Outcomes measured: Adjusted Risk Difference (ARD) of RP and RB* In contrast with the first year of implementation (ARD=-6, p<0.05), this CHW program revealed no significant difference in the proportion of RP (ARD=-4, p>0.10) and RB (ARD=-7, p<0.10) between the intervention and comparison groups after 2 years. This only showed that the program can slightly delay occurrence of RP for 2 month based on tobit analysis. This findings were attributed to the almost equal rate of contraceptive use between the two groups.	• Race (Puerto Rican, African-American) • Enrolment in AFDC	Moderate
Sangalang,	Records of	This employed a	*Outcomes measured:*	• Race	Strong

Study	Sample (During 2nd year evaluation)	Design, Follow-up period and Retention rate	Key Findings	Significant Confounders	Quality Rating
et al. (2006)(16)	**2,520** adolescents aged 12-19 years from North Carolina were obtained. Adolescents in the treatment group were recruited from social service, schools, and juvenile courts. Some were snowballed from current program participants. Most were African-American.	retrospective cohort design wherein those from the treatment group were matched with communities not involved in the program. Only the records was collected for of the comparison group. *Follow-up: 2 and 4 years after birth of first child*	*Adjusted Relative Risk Ratio (ARRR) of RB* Study results showed that adolescent aged 12-16 year from the intervention group had less occurrence of RB than the control (ARRR=-0.229, SD=0.083, p=0.006) 2 years after the delivery of their first child. After 4 years, 66% from the APP group still didn't have any RB compared to control (66%). Adolescent from 17-19 age group did not show any significant results. The study did not show more details about this. Although the study revealed a promising findings, inferences must be made with carefully made because of the design used (non-experimental).	• Age at first birth	
Sims and Luster (2002)(30)	**99** expectant or currently adolescent mother of 13-19 years old (mean age=16.2) were included. Generally, participants were African-Americans and unmarried.	**Random assignment** was done to intervention and comparison (standard health programs) groups. *Follow-up: 24 months* *Retention rate: 69.7%*	*Outcomes measured: Proportion of RP and RB using Adjusted Wald Statistic (AWS)* Analyses of 24th month data showed that being in the treatment group is not a significant predictor to reduce RP (AWS=0.02, p=0.89) and RB (AWS=0.89, p=0.50) despite of low occurrence (RP=58%, RB=33%) compared to control (RP=63%, RB=39%). Study attributed the results to presence of a "control group with intervention" instead of "no-intervention control". Also, it mentioned that the low employment opportunity in the study setting may also prevented the program to optimize its effects.	• Living with male partner	Strong
Solomon and Liefield (1998)(31)	**63** first-time adolescent mother aged below 19 participated while most of them are currently enrolled in	Allocation to treatment and control groups did **not involve randomization**. Control group, receiving no intervention expect for phone call	*Outcomes measured: Proportion of RP using Chi-square* Two years after program enrolment, adolescents in the intervention group significantly had lower proportion of RP (<10%)	• Confounders were not considered during analysis.	Moderate

Study	Sample (During 2nd year evaluation)	Design, Follow-up period and Retention rate	Key Findings	Significant Confounders	Quality Rating
	nutrition supplement program. Most adolescents in the intervention group were from minorities.	reminders for immunization and information update, was matched being outside the zip codes of yet almost adjacent to a treatment area. *Follow-up: 12, 18, 24, and 36 months* *Retention rate: 28%*	unlike the control (38%) (X^2=7.67, p=0.006). Same result was found during the 3-year assessment (X^2=5.40, p=0.020).		

Table 7.1. 3. CHW towards repeated teenage pregnancies and births: Random-effects meta-analysis by selected methodological and program characteristics

	Repeated Pregnancies						Repeated Births					
		Pooled ES		Heterogeneity			n	Pooled ES		Heterogeneity		
Subgroups	n	OR	95% CI	Q	p-value	I^2		OR	95% CI	Q	p-value	I^2
Quality												
Weak	1	1.23	0.90-1.67	NA	NA	NA	2	0.63	0.13-3.12	12.26	0	92
Moderate	6	0.86	0.57-1.30	11.3	0.05	56	2	0.69	0.49-0.97	0.01	0.92	0
Strong	1	0.83	0.37-1.86	NA	NA	NA	3	0.73	0.57-0.95	1.79	0.41	0
Type of Control												
With Intervention	6	1.07	0.90-1.28	4.97	0.42	0	4	0.89	0.58-1.38	6.51	0.09	54
Without Intervention	2	0.31	0.10-1.00	1.73	0.19	42	3	0.48	0.23-0.97	7.06	0.03	72
Type of CHW												
Lay Health Worker	5	0.91	0.58-1.42	10.15	0.04	61	2	0.69	0.49-0.97	0.01	0.92	0
Paraprofessional	3	1.01	0.66-1.54	2.77	0.25	28	5	0.68	0.41-1.12	15.75	0	75
Type of Program												
Supplemental	3	0.96	0.53-1.76	8.32	0.02	76	1	1.37	0.91-2.06	NA	NA	NA
Non-Supplemental	5	0.86	0.66-1.10	1.65	0.8	0	6	0.63	0.48-0.84	7.21	0.21	31
Presence of Supervisor												
With Supervisor	2	1.17	0.88-1.56	0.79	0.38	0	3	0.69	0.26-1.82	12.53	0	84
Without Supervisor	6	0.86	0.57-1.30	11.33	0.05	56	4	0.71	0.58-0.88	1.85	0.6	0
OVERALL	**8**	**0.96**	**0.72-1.28**	**13.49**	**0.06**	**48**	**7**	**0.70**	**0.49-0.99**	**16.37**	**0.01**	**63**

**n-Number of studies; ES-Effect size; OR-Odds ratio; CI-Confidence interval*

Summary

Recent evidence has shown the effectiveness of CHW visitation in reducing RP occurrence by 30%. My meta-analytic review has also identified programmatic issues which might affect the implementation of CHW in other settings. The presence of supervisors negatively influenced CHWs performance, which may reflect poor supportive supervision. CHW deployment as an auxiliary program also diminished CHWs' effectiveness, due to the broad scope of work and impractical expectations. Despite lack of evidence in developing countries, findings from this review have provided insights on how the CHW strategy can be contextualised, especially in countries such as the Philippines where CHW deployment has been known to be effective in providing other public health and social services.

Chapter 8: General Discussion

Introduction

Despite the extensive burden of RP on maternal and child health, no evidence has been established to measure its magnitude, risks, and outcomes in low- and middle-income countries (LMICs) such as the Philippines, where access to reproductive health services is still problematic. This research therefore explored RP trends in the Philippines and analysed how RP trends relate to the consistently high fertility rate and poor access to contraception in Filipino adolescent girls [14, 33]. I also assessed RP adverse outcomes and risk factors to inform future preventative interventions. This project aimed to also address methodological issues identified from recent evidence. The project also used national representative data and longitudinal data from the Philippines to better assess maternal and child outcomes.

This chapter discusses in detail findings from this PhD project by answering the specific research objectives outlined in **Chapter 1**. It also examines the implications of this research in terms of prevention and management of adolescents with RP, and identifies recommendations for future research.

How have trends of RP in adolescent girls changed overtime?

I explored patterns of adolescent fertility by examining RP's twenty-year trend. In a national context that shows an increased proportion of first-time pregnant adolescents [7], my study found that from 1993 to 2013, the twenty-year trend of RP among Filipino adolescents has remained high, at ~20% prevalence. This means that in 2013, one in five adolescents still experienced a repeated pregnancy regardless of region of origin, type of residence, and wealth quintiles. This alarming trend may be attributed to the unique socio-cultural and political situation in the

Philippines, where adolescents, including those who already have children, are unable to access contraception and other family planning services [54, 161].

There are several possible interpretations to this finding. Apart from personal beliefs and familial dynamics, community perceptions are likely to shape adolescents' attitudes to delay another pregnancy and decisions towards contraception. The strong influence of religious groups on community values and lack of support for modern methods of contraception [33, 98] may have negatively affected local implementations of reproductive health programs and policies [34, 91]. In the Philippines, the constant arguments of the Catholic Church against reproductive health laws [162] have prevented the current legislation on sexual education and family planning from embracing specific programmatic actions to address RP [10]. Hence, minors, including those with children, are still unable to access contraceptives without parental consent [120]. Evidence from other countries suggest that similar types of prohibitions have led to high adolescent fertility as well as stigma against birth control [163]. Policy restrictions such as these may explain the unchanged RP trends in the Philippines and possibly in other LMICs.

What happens during a repeated pregnancy?

My study suggests that repeated pregnancies during adolescence increase the risk of obstetric complications and developmental delays among subsequent biological children.

In addition to the existing evidence on maternal infections, pregnancy-induced hypertension [113], maternal haemorrhaging [164], and preterm deliveries [73], I found an increased risk of any type of pregnancy and labour complications during a repeated pregnancy. As female physiological growth during adolescence is not fully developed to cope with childbearing [165, 166], a repeated pregnancy can exacerbate health related risks. Physiological maturity is unlikely to change since a first pregnancy [17, 24-26] and emotionally, adolescents are also likely to remain unprepared to sustain a subsequent pregnancy [17, 25, 26]. These findings only partly support the existing evidence. For example, a recent hospital-based research study with pregnant adolescents showed a null association between a higher birth order and gestational complications [72]; however, the lack of association in that study may be due to insufficient statistical power as well as selection bias as the study excluded mothers who had home deliveries [167].

Subsequent children of adult women have an increased chance of stunting recovery within the first two years of life compared to latter stages [168]; however, I found children of adolescent and young women were more likely to show persistent stunting from 12 to 24 months of age. While there was no statistically significant difference between the offspring outcomes of those younger than 20 compared with those aged 20-24 years, elevated estimates still suggested the possibility of greater risk of persistent stunting in children of adolescents compared with the children of young mothers. My paper adds to the existing evidence by detecting birthweight and feeding practice as mediators [169, 170] which other studies were not able to account for [86, 171]. These two factors potentially explain the underlying mechanism about the strong linkage between RP and child stunting. These findings also point for interventions addressing low birthweight and sub-optimal feeding practices in adolescents to ultimately improve children’s growth 24 months after birth.

Do adolescents after their first pregnancy show poorer maternal and child outcomes?

While earlier research suggests a reduced risk for obstetric and neonatal morbidity among adult women with high parity scores [172], my study showed adverse maternal and child outcomes following adolescents' second pregnancy. These can be due to insufficient time for physiologic and psychosocial 'recovery' following the first pregnancy. Adult women usually recover from 24 to 36 months postpartum [169, 170] because of their mature physiology resulting from paternal antigen desensitisation [154] and modification of maternal arteries [155]. From a physiological perspective, female bodies are still unprepared for pregnancy during the teenage years [23], and unlikely to meet the necessary nutritional requirements [173] as well as the competing foetal demands of RP [174, 175] and demands of pubertal development [176-178]. From a social perspective, RP is likely to cause further educational disruption, inadequate socio-economic resources [143], and poor human capital [68]. Remaining in socio-economic disadvantage [178] may lead to suboptimal nutrient intake, maternal underweight [74], and can also prevent adequate infant feeding [68].

Although resilience and life skills are often gained after a first pregnancy [179], a repeated pregnancy can cause further tension between adolescents' developmental tasks and the pressures and demands of parenthood [29, 66, 180]. Occurrence of a repeated pregnancy can position adolescents to further role conflicts and challenges of subsequent parenting. These conflicts at this developmental stage often result in an inability to master developmental tasks which can further lead to poor parenting and disinterest in seeking healthcare [29, 67, 165].

This crisis can also result from the discordance between the developing cognition of adolescence, problem-solving and decision-making abilities [66]. Contradictory identity roles, such as mother, wife, daughter, student, and peer, may interfere with the development of the individual capital needed to parent a subsequent child. My findings on suboptimal feeding by women younger than 20 years following a repeated pregnancy, provide some support for this interpretation as inadequate breastfeeding and improper introduction of solid foods may impact on growth trajectories within the first two years of a child born from a repeat pregnancy [181, 182]. Socio-cultural factors can further aggravate this crisis [183]. In my study, adolescents often refrained from consulting trained birth attendants. This practice is likely to impact on access to appropriate health facilities and service providers [184, 185] and delay health consultations, particularly for severe obstetric symptoms [74]. This is confirmed by results from **Chapter 5** where adolescent women who experienced pregnancy and labour complications significantly delayed their seeking of prenatal care [158].

Figure 8. 1 shows how RP can influence adverse maternal and child health outcomes in line with my research findings.

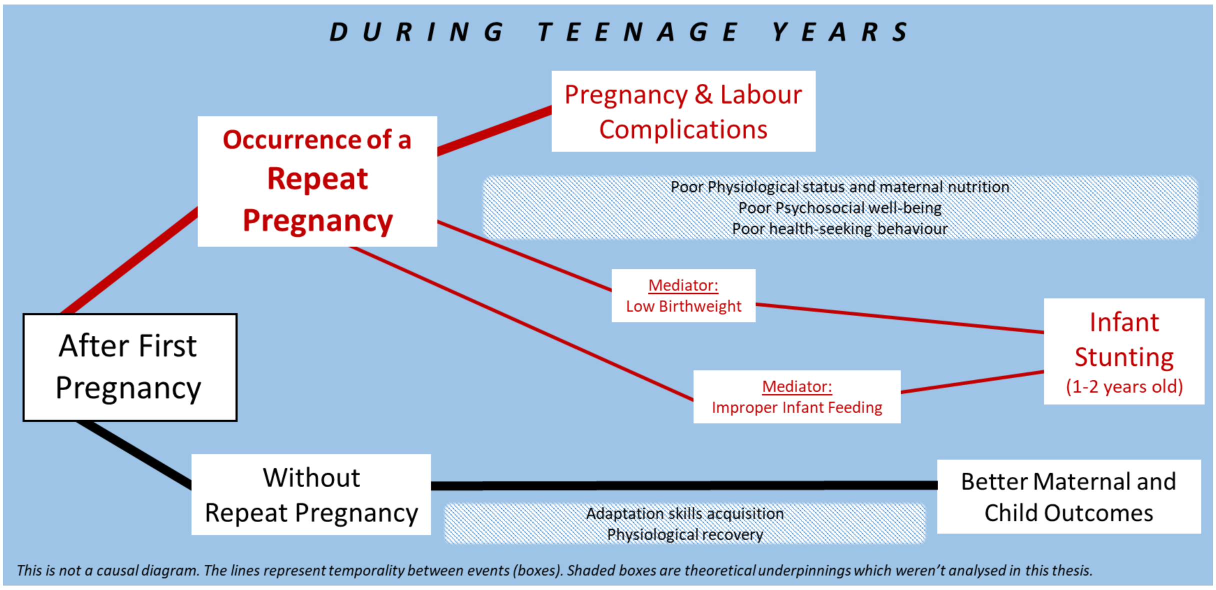

Figure 8. 1. Maternal and stunting outcomes of repeated adolescent pregnancy

Is it all just about contraception?

Identification of key RP factors is essential to avert health consequences for both adolescents and their children and to develop future preventative interventions. Family planning has been shown to prevent subsequent unintentional pregnancies by encouraging contraception plans and intentions to delay subsequent pregnancies [47, 63, 94]. I found that adolescents who used long-acting reversible methods such as IUD, Depo-Provera, and subdermal implants effectively reduced pregnancy recurrence [63] compared to those who did not.

Despite the strong influence of contraceptive use in reducing RP risk, there are other factors that directly or indirectly affect adolescents' decision to delay their second pregnancy [78, 87, 88]. There was an increased RP risk among Filipino adolescents who had their first birth before 18 years. This is not surprising, as younger age at first birth allows longer risk exposure to RP during teenage years [63]. This association was also found in a Brazilian hospital-based cross-sectional study [93], and a US-based longitudinal youth survey [87].

I also found an increased RP risk among Filipino adolescents who used traditional healers as main providers of prenatal care. It is possible that traditional healers tend to provide inaccurate family planning information and advice [186], resulting in misconceptions about modern contraceptives [187], whereas health professionals will likely introduce modern family planning options and empower informed decision-making about postpartum contraceptive use [185].

Adolescent girls who were living together with their partners were more likely to become pregnant again. This resulted from frequent 'unprotected' sexual contact [60] especially if partners have limited knowledge and/or negative perceptions of contraception [93]. Being in a relationship with an older partner may also increase

RP risk due to adolescents' limited financial independence leading to reduced autonomy on family planning decisions [102, 108]. Also, older male partners (i.e. >24 years old) especially from LMICs rarely use modern contraception [188], which will also increase RP risk [189-191].

How similar or different is the Philippine situation from other countries?

My findings support findings from other countries in a number of ways. Despite differences in study designs, my research and previous studies similarly showed positive associations between being in a de facto relationship and RP risk [60, 93, 95, 100]. My meta-analysis of the existing literature on partner's age confirms my results from Philippines National Demographic and Health Survey (NDHS) data about the risk effect of having an older partner [33, 95, 100, 102].

My research showed that Filipino adolescents who were below 18 years of age at first birth, and who were from a lower income class were at higher risk of RP. Previous studies on the effects of age and income class on RP risk in adolescents have yielded mixed results. These may be due to how these exposures were analysed in previous studies and different level of adjustment for relevant confounding. Age at first birth was often used as categorical or continuous. Using age as a categorical variable takes the average effect of each value of age depending on the cut-off instead of accounting for the increase by one year. This may explain the statistically significant associations found in my study after grouping age into two. Level of adjustment for confounders also varied across studies (*Paper 6.1*). Studies that have adjusted for obstetric factors, similarly to my study (*Paper 6.2*), have yielded negative associations [87, 93] whereas studies with no adjustments showed positive associations [102, 106, 107], resulting in a null pooled effect as shown in *Paper 6.1*. Socio-economic status was defined differently across studies. In my study, I defined socio-economic status in terms of wealth index compared to studies which only measured socio-economic status using monthly household income [63]. As a composite variable, wealth index is not only comprised of household income but also of housing materials, house ownership, and sanitation [111], which may better reflect the complexity of socio-economic status.

My research is one of the first studies to show that consulting traditional birth attendants for prenatal services increases the risk of repeated pregnancy in adolescents. This issue has not been investigated at length in previous studies. For example, although a study in Brazil showed significant association between prenatal care and RP, prenatal care was defined as the actual receipt of prenatal care (yes or no) without further mention of the type of prenatal care provider [93]. My findings suggest a need for further investigation, particularly in countries with a high number and acceptance of traditional birth attendants.

Table 8. 1. Comparison of important risk factors* identified using the Philippines NDHS and meta-analytics review of 26 articles

Risk Factors	Philippine NDHS (Paper 4.1 and 6.2)	Meta-analysis (Paper 6.1)
Individual Level		
Young age at first birth	✓	×
Didn't complete high school	×	✓
Intended first pregnancy	×	✓
Depression	ND	✓
History of abortion/miscarriage	ND	✓
School discontinuation	ND	✓
Interpersonal Level		
Older partners	✓	✓
De facto status	✓	✓
Increased partner support	ND	✓
Peers who are teen mothers	ND	✓
Community Level		
Consulted traditional birth attendants during first pregnancy	✓	ND
Lower income class	✓	×

Legend: Associated (✓); Not associated (×); No data (ND)
*This list excludes contraceptive use due to its obvious protective effect.

Does religion influence adolescents' subsequent pregnancy?

The Catholic Church's stance against family planning and use of modern contraception [192] has affected community norms and interfered with the implementation of the country's Reproductive Health law [35]. However, I have found an individual's professed religious status to be non-influential for RP risk. A recent longitudinal analysis in the Philippines of women aged 25 years corroborates this finding. This study found null associations for being a Catholic and frequent church attendance (i.e. religiosity) while using the number of living children as the outcome [116]. This unexpected result from my cross-sectional analysis confirmed by findings from this previous longitudinal study [116] can be related to data limitations in testing my primary assumption on the effects of religion. The data I had available for analysis may not be sensitive enough to measure how religion and religiosity affect adolescents' value systems and access to family planning services before a second pregnancy [193]. More research is needed using more sensitive data sources to investigate this issue further.

Overall, my research identified intervenable factors that suggest the complexity of repeated adolescent pregnancy in the Philippines (see Figure 8.2 overleaf). Knowing that these factors are modifiable provides an array of opportunities to develop preventative interventions.

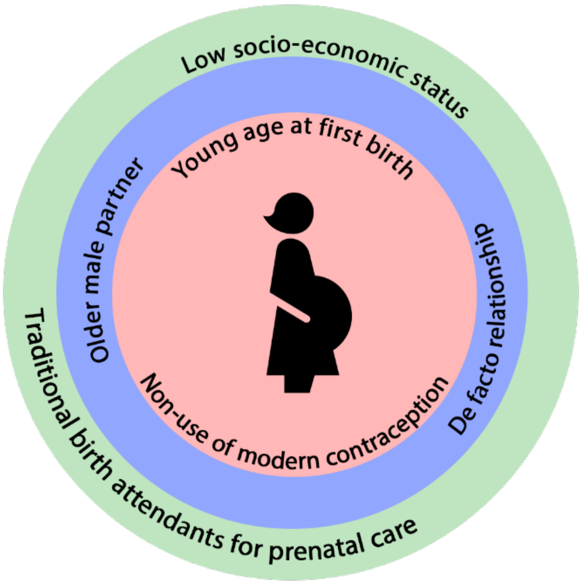

Figure 8. 2. Correlates of repeated adolescent pregnancy

Implications

Repeated pregnancy prevention

Prevention initiatives have only focused on adolescents' first pregnancy, instead of subsequent conceptions [179]. My study suggests high RP prevalence and a need for subsequent pregnancy prevention programs that address important risk factors.

Despite the availability of trained service providers, adolescents often turn to traditional healers due to the accessibility and low cost of these antenatal services [194, 195]. Establishing home visitations by trained providers, such as community health workers (CHWs), would pro-actively deliver counselling and family planning services especially after adolescents' first pregnancy [54, 196]. Home visitations are known to improve contraceptive uptake since they allow adolescents to discuss issues/concerns and promote partner's participation, thereby encouraging shared decision-making towards birth control [122] . Although this study did not investigate CHWs' effectiveness in the Philippines, evidence from other countries has suggested home visitations by CHWs reduce RP risk and are cost effective [197] (see **Chapter 7**). CHWs are normally trained to provide a range of services in a non-judgmental way. These services may boost adolescents' readiness and decision-making abilities and include family planning, parenting information, and educational and emotional support [197]. Some initiatives have incorporated peer support as part of home visiting initiatives to encourage school retention and community-based psychological interventions to improve access to mental health services [47, 54, 198, 199].

Strategies targeting low-income households would cover a significant proportion of adolescents who are at RP risk. The conditional cash transfer initiative in the Philippines, which has been found to be effective at improving health and social outcomes for 4.5 million poor Filipino households [200, 201], could potentially be harnessed to deliver RP related services. This initiative requires attendance at 'family development seminars', family planning counselling if necessary, and continuation of secondary education for women aged 15-45 years to receive cash incentives [200]. An evaluation of a similar program in Mexico has found a reduction in pregnancy occurrence and an improvement in the uptake of contraception specifically among teenagers and young adults [201].

Assisting adolescents and children to cope with repeated pregnancies

Increased risks of adverse outcomes were observed among adolescents during their second pregnancy in my study. Early access to maternal services would mitigate maternal complications such as pre-eclampsia, anaemia, and haemorrhaging. Since adolescents often receive inadequate prenatal care [202], strategies to promote early and sufficient antenatal visits may be warranted. Educational sessions about birth planning and early signs in pregnancy may prompt regular antenatal checks [203, 204]. Gaining resilience by focusing on life skills, decision-making abilities and stress management has also been found effective to improve psychosocial adaptation and future pregnancy outcomes [179].

Improving health workers' competence and attitude, through training in appropriate communication techniques, would help them achieve a better understanding of adolescent behaviour and ultimately improve adolescent – health worker relationships. Recalibrating antenatal services as adolescent-friendly was found to be effective in increasing facility visits and health seeking behaviour [41]. This may be particularly helpful in countries such as the Philippines, where young pregnant women face stigma and discrimination from both the community and health facilities and may therefore be drawn to seek the assistance of traditional healers instead of service providers [205].

Prevention of low birthweight and promotion of optimal feeding practices may require interventions as early as the pregnancy stage [206, 207]. Maternal nutrition supplementation has the potential to reduce the likelihood of low birthweight and stunting alongside their longer term effects [208]. Promotion of optimal feeding practices [157, 209] can also increase recovery from stunting, particularly in the first two years of life [210].

Strengths and limitations

My study places RP as an issue of public health importance due to the associated health and social burden for adolescents and their children. This research contributes to the field of adolescent reproductive health by establishing prevalence, trends, risk factors and outcomes of RP in low- and middle-income countries. Despite the availability of nationally representative data in LMICs [211, 212], no study has attempted to specifically explore the magnitude, distribution, and impact of

RP using a systematic approach. I used my meta-analysis results as a guide before designing my research papers—thus, ensuring that analyses were informed by the latest evidence. I have also used a more precise definition of RP. Previous articles in the USA, Europe, and Australia [63] have not accounted for pregnancy loss, such as miscarriage, in defining RP. In my study, I have measured number of pregnancies instead of births, since number of pregnancies has programmatic and preventative implications, especially in the Philippines where abortion is illegal.

I addressed a range of methodological weaknesses evident in previous studies. I used individual-level data instead of aggregate estimates when examining prevalence trends—this eliminates ecological fallacy, particularly when investigating year–age interaction and interaction with other macro-level indicators (i.e. wealth quintile, region, and type of residence). I have accounted for residual biological factors [74] and possible socio-economic changes between pregnancies [80] by comparing the first and second pregnancy experience of the same adolescent girls while adjusting for clustering effects. This approach has never been used in previous studies which have compared the average effects of a group of mothers who had one pregnancy, to another group of mothers with two pregnancies [73, 74]. My study has accounted for the effects of higher parity scores (i.e. >2) on maternal outcomes [172], which was often seen in past cross-sectional studies [22]. I focused on the first two pregnancies during teenage years which showed more precise change in adolescents and child outcomes during the ‘event’ of a second (repeated) pregnancy. This avoided overestimation as well as underestimation due to recall bias.

I explored differences within specific groups (i.e. age group, socio-economic status, inter-pregnancy interval). This enabled us to demonstrate disparities between different sub-groups [86, 213]. For example, differences found in adolescents and young adults relate to their respective developmental stage, while differences across socio-economic class reflect adolescents' access to healthcare and information. Also, my analysis has provided insights into the mechanisms behind the relationship between RP and stunting risk, which is a novel contribution to existing literature on infant stunting [214].

This research has also some limitations. As with all cross-sectional studies, findings using NDHS cannot be used to establish causality between RP and its risk factors. Important correlates such as socio-economic status, education, and contraceptive use were reported at the time of the survey and do not necessarily reflect temporal links prior to the occurrence of RP. Measuring these factors between the first and second pregnancy qualifies those as predictors. Although an established theoretical framework has supported the correlates analysed in this study [88], careful interpretation of the results is needed as some factors could have been the result of RP instead of its predictors (see *Paper 6.2* discussion on this).

Due to the sensitive nature of the data being collected, self-reported measures may be subject to under-reporting. While insufficient record validation has been widely observed across the NDHS from all countries, the Philippines NDHS questionnaires [9] enabled respondents to clearly describe these measure by repeating questions and probing. This also enabled cross-checking responses during the interview. Evidence also suggests reliability of self-reported measures in identifying maternal-related variables including causes of morbidity and health history [215]. Self-reports have also been found to accurately reflect health service utilisation [216] and pregnancy experiences in adolescent girls [175, 217].

For some analysis, I had reduced statistical power to detect interaction and analyse cross-sectional trajectories. While NDHS recruited a considerable number of adolescents, further selection of those who had at least one pregnancy reduced my sample by ~50% for most analyses.

Lastly, the secondary data available for this project did not include information on behaviour and nutrition. Depression and school discontinuation have been found to be highly influential RP predictors in other research [63]. However, the Demographic and Health Surveys (DHS) does not contain data on depression and school attendance since the DHS is designed to evaluate maternal and child health and demographic indicators. In the CLHNS, depression information was only collected in 2002 when mothers were around 30 years old. Both these constraints limit my capacity to account for pre-existing depression, any history of postpartum depression or any depression episodes that occurred between surveys, which may have affected my results.

Recommendations for future research

My study has strongly indicated that adolescent girls in the Philippines are at a high risk of RP due to individual and societal risk factors. This body of work is one of the first to research the magnitude and complexities of repeated adolescent pregnancy in this country. However, due to a few limitations of this research, further epidemiological investigations using more rigorous methods and a larger study population are needed.

Current evidence suggest miscarriages, depression, and school discontinuation as important predictors of RP [63]. I recommend exploring the effect of these predictors on fertility and family planning attitudes in LMICs. A miscarriage may lead to another pregnancy as a mechanism for coping with pregnancy loss [101]. Unplanned adolescent pregnancy has also been related to prenatal and post-natal depression [218]. Post-natal depression often triggers risky sexual behaviours and poor attitude towards family planning [95]. Further, education systems in LMICs do not easily accommodate pregnant adolescents, and this may lead to school drop-out. School discontinuation is likely to discourage the pursuit of alternative life goals and this may lead to the belief that parenting and bearing more children is the only available role [83].

Future longitudinal data would strengthen claims I have made from this research. Longitudinal data would enable evaluating various proximal and distal RP predictors and identification of relevant mediators. For example, the association of repeated pregnancy with use of traditional birth attendants can be mediated via lack of contraceptives, lower socio-economic position and/or poor family planning attitude. Panel data would be beneficial to determine physiologic and social outcome trajectories from adolescence, young adulthood and late adulthood. Apart from RPs' maternal and developmental impacts across the life course, repeated measures on social attributes can determine patterns and changes in socio-economic status and educational outcomes.

Low- and middle-income countries may vary in the prevalence, trends and risk factors due to environmental and cultural differences. A multi-country analysis would be valuable in obtaining a broader RP status, and would facilitate the identification of high RP burden countries and the program development on a global scale. Availability of DHS data in more than 80 countries improves the feasibility of coming up with national, regional, and global RP estimates across time at different aggregate levels. In addition to cross-sectional surveys, longitudinal datasets can also be used to produce more robust estimates. There are five known cohorts in low- and middle-income countries which allow prospective analysis and advanced epidemiological procedures [219]. Projections and maps that can be produced from these datasets will facilitate target setting for future public health programs both at regional and national levels with various topography and socio-cultural characteristics [220-222].

My research highlights the importance of understanding the effect of a country's socio-political context on adolescents' access to reproductive health services. Hence, future research could triangulate information about political and health system landscapes with epidemiologic findings to elicit a clearer explanation about emerging RP trends in national, regional, and global schemes. While my research identified practical implications solely based on observational epidemiology, future studies that account for both epidemiological and health policy and systems constructs would provide additional practice and policy recommendations to improve service delivery and avert adverse outcomes related to repeated pregnancies in adolescent girls.

Conclusions

This research presents a multi-dimensional understanding of repeated adolescent pregnancy using robust analysis to measure magnitude, maternal and child health consequences, and factors at levels of influence. In addition to lack of contraceptive use, adolescents younger than 18 years old who have an older partner and who used traditional birth attendants as their prenatal care providers have an elevated RP risk. Using a national representative sample, I found that one in every five adolescent mothers experienced an RP in the Philippines, which demonstrates that repeated pregnancy has continued to affect Filipino adolescents for more than two decades. I also found an increased risk for pregnancy and labour complications during adolescents' second pregnancy and that RP also affects children from a repeated pregnancy with persistent stunted growth between the ages of one and two years.

Although not all potential predictors were analysed in this study, my findings provided insights and opportunities for future development of secondary prevention interventions. Involvement of partners may be beneficial to enable informed decision-making on family planning. Access to trained antenatal care providers may also reduce the risk for maternal-related complications and improve contraceptive uptake among adolescent mothers. In-depth understanding of the behavioural component of RP would produce a comprehensive framework to inform future community-based interventions. As this research provides data about the RP situation of a single country, this study calls for exploration of the global situation as well as the local contexts in other LMICs with high burden on adolescent fertility while accounting for cultural and socio-political intricacies.

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Appendices

Appendix 1: Ethics Approval

School of Public Health

THE UNIVERSITY OF QUEENSLAND

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To	Mr Joemer Calderon Maravilla
From	Lisa Fitzgerald
Date	11 April 2016
Re	Ethics Approval JCM11042016

Dear Joemer,

Thank you for your application for ethics approval for your research:

Research topic:

Factors, outcomes and trends of repeated adolescent pregnancy and birth in the Phillipines

The School of Public Health Research Ethics Committee has reviewed the materials submitted for review. Ethics approval is given.

Yours faithfully

Lisa Fitzgerald
Chair, School of Public Health Research Ethics Committee
School of Public Health, University of Queensland

Appendix 2: Online supplementary material of paper 4.1

This material supplements but does not replace the content of the peer-reviewed paper published in Reproductive Health.

Table S. 1. Characteristics of National Demographic and Health Survey (NDHS) Philippines from 1993 to 2013

Characteristics	Year				
	2013	**2008**	**2003**	**1998**	**1993**
Sampling					
Frame	2010 Census	2000 Census	2000 Census	1995 Census	1990 Census
Design	Stratified Two-stage *First stage:* Systematic selection of 800 Enumeration Areas (EAs) distributed by region (17) and type of residence (rural, urban) *Second stage:* Systematic selection of 20 housing units per EA (maximum of 3 households per unit)	Stratified Three-stage *First stage:* Selection of PSUs *Second stage:* Selection of 794 EAs *Third stage:* Selection of 17 housing units per EA through systematic random sampling (maximum of 3 households per unit)	Stratified Three-stage Cluster *First stage:* Selection of 819 PSUs *Second Stage:* Selection of EAs per PSU *Third stage:* Systematic selection of 17 households per EA	Stratified Two-stage *First stage:* Selection of 752 EAs on 16 regions *Second Stage:* Systematic selection of households in urban while cluster sampling among rural areas	Stratified Two-stage *First stage:* Selection of 750 PSUs distributed among 14 regions Second stage: Selection of 20 households per PSU
Response Rates					
Households	99.2	99.3	99.1	98.7	99.2
Women (15-49 years old)	98.3	98.3	97.8	97.2	98
Sample Size					
Households	14,804	12,469	12,586	12,407	12,995
n of Women (15-19 years old)	3,261	2,766	2,646	2,949	3,139
Weighted % distribution	20%	20.2%	19.4%	20.9%	21%
n of Women (15-24 years old)	6,070	4,909	4,860	5,190	5,741
	37.3%	36%	35.6%	37.3%	38.6%

Table S. 2. STROBE Statement

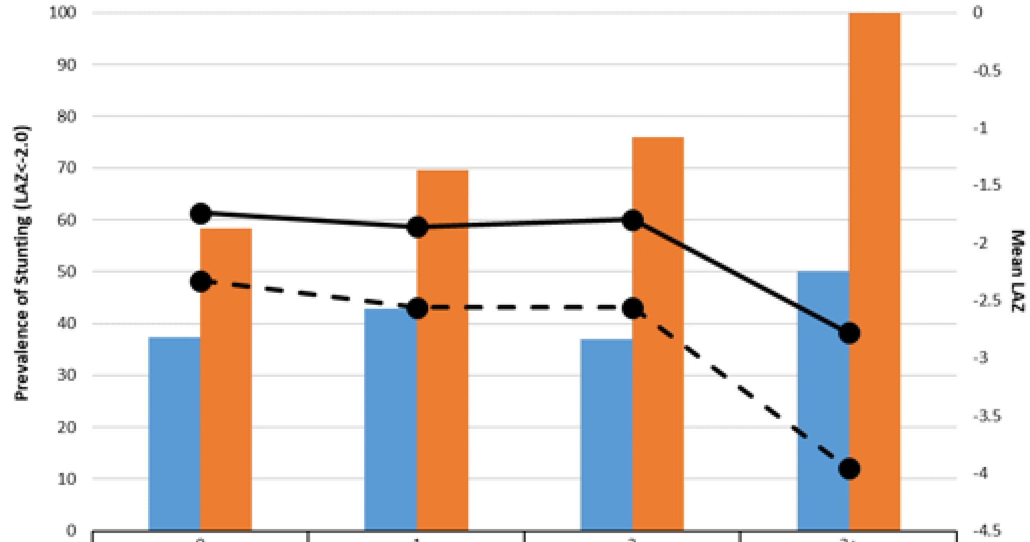
	Item No.	Recommendation	Page No.
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7-8
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	7
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	7-8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*7*
Bias	9	Describe any efforts to address potential sources of bias	8-9
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	N/A
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for	10, Table 1,

	Item No.	Recommendation	Page No.
		eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Appendix A
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10, Table 1
		(b) Indicate number of participants with missing data for each variable of interest	N/A
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	
		Cross-sectional study—Report numbers of outcome events or summary measures	10, Table 1
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-11, Table 2, Figures 1-2
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11, Tables 3-4
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15-16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-15, 17
Generalisability	21	Discuss the generalisability (external validity) of the study results	14-16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2, 9, 18

Appendix 3: Online supplementary material of paper 5.2

This material supplements but does not replace the content of the peer-reviewed paper published in BMJ Sexual and Reproductive Health.

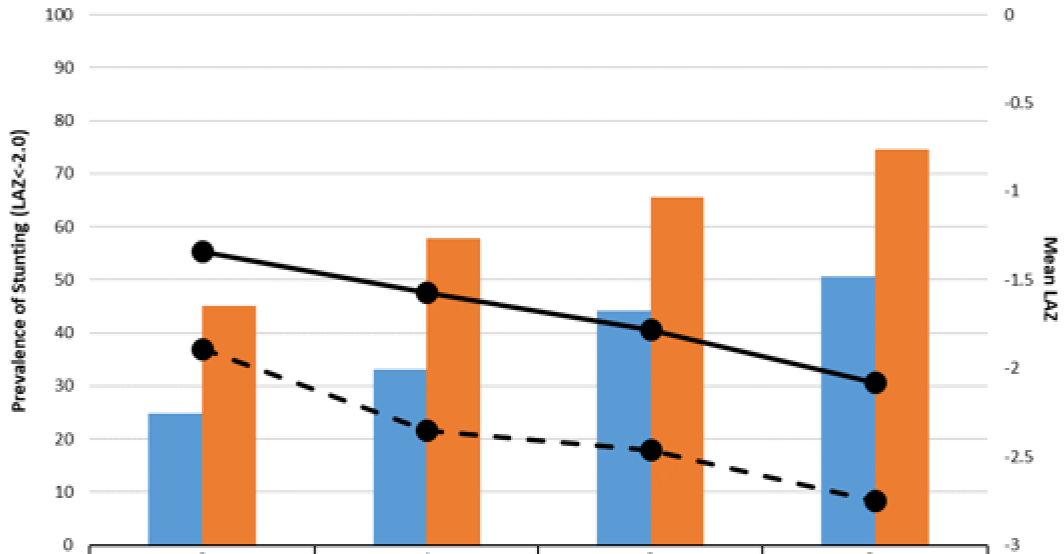
(a) <20 years old



	0	1	2	3+
12 months	37.31	42.86	37.04	50
24 months	58.29	69.57	76	100
12 months	-1.74	-1.86	-1.80	-2.78
24 months	-2.33	-2.56	-2.56	-3.96

Number of Past Pregnancies

(a) 20-24 years old



	0	1	2	3+
12 months	24.77	33.19	44.26	50.69
24 months	45.12	57.87	65.54	74.64
12 months	-1.34	-1.57	-1.78	-2.08
24 months	-1.89	-2.35	-2.46	-2.75

Number of Past Pregnancies

Figure S. 1. Prevalence of stunting and mean length-for-age z scores (LAZ) at 12 and 24 month follow-up by number of past pregnancies and age group

Table S. 3. Occurrence and persistence of stunting in the first 24 months of life of offspring of teenage and young adult mothers with repeated pregnancy

Outcomes	Age Groups					
	<20 years old			20–24 years old		
	Univariate	Multivariate	Multivariate with RPxIPI%	Univariate	Multivariate	Multivariate with RPxIPI%
LAZ at 12 months*$	-0.13 (-0.31-0.05)	-0.32 (-0.58-0.06)	-0.20 (0.214)	**-0.21 (-0.27- -0.14)**	**-0.15 (-0.23- -0.07)**	0.10 (0.210)
Stunting at 12 months*@	1.12 (0.82-1.53)	1.47 (0.80-2.69)	0.22 (0.759)	**1.40 (1.17-1.68)**	**1.41 (1.18-1.69)**	-0.27 (0.111)
LAZ at 24 months+$	**-0.26 (-0.44- -0.09)**	**-0.37 (-0.62- -0.13)**	0.07 (0.794)	**-0.25 (-0.31- -0.19)**	**-0.13 (-0.21- -0.05)**	0.09 (0.255)
Stunting at 24 months+@	**1.62 (1.12-2.35)**	**2.51 (1.17-5.36)**	0.65 (0.555)	**1.47 (1.29-1.68)**	**1.22 (1.01-1.48)**	-0.06 (0.737)
Persistence of Stunting^?						
Persistent	**1.64 (1.05-2.54)**	**3.29 (1.23-8.84)**	11.84 (0.116)	**1.65 (1.41-1.92)**	**1.46 (1.17-1.84)**	0.77 (0.229)
Late Incident	1.25 (0.44-3.54)	**2.91 (1.12-7.57)**	3.01 (0.459)	**1.30 (1.11-1.54)**	1.08 (0.85-1.37)	0.96 (0.863)
Recovered	**1.95 (1.24-3.05)**	**7.38 (1.08-50.34)**	10.47 (0.360)	0.97 (0.67-1.39)	1.36 (0.81-2.64)	0.45 (0.199)

Abbreviations: IPI-Inter-pregnancy interval; LAZ-Length-for-age Z-score; RPxIPI- 2-way interaction between number of past pregnancies and IPI; IPI and Age group
*The multivariate model was adjusted for IPI, maternal age, maternal height, partner's age, birthweight, feeding practice, socio-economic characteristics, diarrhoea at 12 months, pregnancy complications and antenatal visits
+The multivariate model was adjusted for IPI, maternal age, maternal height, partner's age, birthweight, feeding practice, socio-economic characteristics, diarrhoea at 24 months, pregnancy complications and antenatal visits
^The multivariate model was adjusted for IPI, maternal age, maternal height, partner's age, birthweight, feeding practice, socio-economic characteristics, diarrhoea at 12 and 24 months, pregnancy complications and antenatal visits; Estimates are in regression coefficient (95% Confidence Interval); Reference group for outcome is 'Normal'
$Estimates are in Mean difference (95% Confidence Interval)
@Estimates are in Odds Ratio (95% Confidence Interval)
?Estimates are in Relative Risk Ratio (95% Confidence Interval)
%Interaction coefficient (p-value)

Table S. 4. Mediated effect of maternal age in years and stunting via repeated pregnancy in standardized regression coefficients and 95% confidence intervals

Outcomes	Total Effect of Age	Indirect Effect of Age via RP	Direct Effect of Age	Direct Effect of RP
LAZ at 12 months*&	0.004 (-0.07 -0.08)	**-0.05 (-0.08- -0.03)**	0.06 (-0.02-0.13)	**-0.16 (-0.24- -0.09)**
LAZ at 24 months+&	0.01 (-0.05- 0.80)	**-0.05 (-0.07--0.03)**	0.06 (-0.01-0.14)	**-0.16 (-0.23- -0.08)**
Stunting at 12 months*	0.01 (-0.10-0.12)	**0.06 (0.03-0.10)**	-0.06 (-0.09-0.10)	**0.34 (0.15-0.51)**
Stunting at 24 months+	0.01 (-0.11-0.08)	**0.05 (0.01-0.08)**	-0.06 (-0.16-0.05)	**0.23 (0.05-0.41)**
Persistence of Stunting^				
Persistent	0.02 (-0.14-0.10)	**0.09 (0.04-0.14)**	-0.11(-0.24-0.02)	**0.46 (0.22-0.70)**
Late Incident	0.01 (-0.13 - 0.12)	0.02 (-0.02 - 0.06)	-0.03 (-0.16-0.10)	0.13 (-0.09 -0.35)
Recovered	0.06 (-0.36- 0.28)	0.06 (-0.07 - 0.15)	-0.12(-0.42 -0.22)	0.41 (-0.07-0.90)

Abbreviations: RP-Repeated pregnancy; IPI-Inter-pregnancy interval; LAZ-Length-for-age Z-score
*Adjusted for IPI, maternal height, partner's age, birthweight, feeding practice, socio-economic characteristics, diarrhoea at 12 months, pregnancy complications and antenatal visits
+Adjusted for IPI, maternal height, partner's age, birthweight, feeding practice, socio-economic characteristics, diarrhoea at 24 months, pregnancy complications and antenatal visits
^Adjusted for IPI, maternal height, partner's age, birthweight, feeding practice, socio-economic characteristics, diarrhoea at 12 and 24 months, pregnancy complications and antenatal visits
&Considered age as continuous instead of binary

Appendix 4: Online supplementary material of paper 6.1

This material supplements but does not replace the content of the peer-reviewed paper published in American Journal of Obstetrics and Gynecology.

Table S. 5. MOOSE Checklist for Meta-analyses of Observational Studies

Item No	Recommendation	Reported on Page No
Reporting of background should include		
1	Problem definition	5-6
2	Hypothesis statement	6
3	Description of study outcome(s)	7
4	Type of exposure or intervention used	7
5	Type of study designs used	7
6	Study population	7
Reporting of search strategy should include		
7	Qualifications of searchers (eg, librarians and investigators)	8
8	Search strategy, including time period included in the synthesis and key words	7
9	Effort to include all available studies, including contact with authors	7
10	Databases and registries searched	7
11	Search software used, name and version, including special features used (eg, explosion)	7
12	Use of hand searching (eg, reference lists of obtained articles)	7
13	List of citations located and those excluded, including justification	7
14	Method of addressing articles published in languages other than English	7
15	Method of handling abstracts and unpublished studies	7
16	Description of any contact with authors	7
Reporting of methods should include		
17	Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	7
18	Rationale for the selection and coding of data (eg, sound clinical principles or convenience)	7-8
19	Documentation of how data were classified and coded (eg, multiple raters, blinding and interrater reliability)	8
20	Assessment of confounding (eg, comparability of cases and controls in studies where appropriate)	8
21	Assessment of study quality, including blinding of quality assessors, stratification or regression on possible predictors of study results	8
22	Assessment of heterogeneity	8-10
23	Description of statistical methods (eg, complete description of fixed or random effects models, justification of whether the chosen models account for predictors of study results, dose-response models, or cumulative meta-analysis) in sufficient detail to be replicated	8-10
24	Provision of appropriate tables and graphics	8-10
Reporting of results should include		
25	Graphic summarizing individual study estimates and overall estimate	12-13
26	Table giving descriptive information for each study included	11-12; Appendix
27	Results of sensitivity testing (eg, subgroup analysis)	14-16
28	Indication of statistical uncertainty of findings	14-16
Reporting of discussion should include		

29	Quantitative assessment of bias (eg, publication bias)	13; Appendix
30	Justification for exclusion (e.g., exclusion of non-English language citations)	11, 18
31	Assessment of quality of included studies	12, 19
Reporting of conclusions should include		
32	Consideration of alternative explanations for observed results	16-19
33	Generalization of the conclusions (ie, appropriate for the data presented and within the domain of the literature review)	17-19, 20
34	Guidelines for future research	17-19, 20
35	Disclosure of funding source	1

Table S. 6. Definitions of the 47 predictors used during meta-analysis

Predictor	Definition	Reference Group
A/PNC visitations	Visited the facility during prenatal or postnatal period	Did not visit the facility
Adolescent's mother was a teen mother	The biological mother of the adolescent was a teen parent	The biological mother of the adolescent was NOT a teen parent
Age at first sexual intercourse	Age during first sexual intercourse in years	NA
Age at menarche	Age during first menstruation in years	NA
Age during first conception	Age during first conception/pregnancy in years	NA
Age of the father at baseline	Age of the partner of the adolescent in years during the baseline data collection	NA
Age of the teenager	Age of the teenager in years	NA
Alcohol use	Drank any alcohol before the repeat pregnancy	Did not drink any alcohol before the repeat pregnancy
Depression	Depression score using a scale	
Drug use	Ever used illegal drugs	Never used illegal drugs
Education of adolescent's mother	More than high school	Less than high school
Educational/career goals	Has career or educational plan	Has no educational plan
Employment	Employed	Unemployed
Experienced physical or sexual abuse	Experienced physical or sexual abuse	Has not experienced physical or sexual abuse
Frequency and recency of sexual intercourse	Number of times of intercourse in the past month	NA
Having a contraceptive plan	Having a plan for contraception/family planning	No plan for contraception
Highest level of education	At least a high school graduate	Did not graduate high school
History of abortion/miscarriage	Have experienced abortion or miscarriage	Never experienced depression or miscarriage
Household size	Number of members in the household	NA
In a relationship with the father of their first child	Being in a relationship (dating, married, cohabitating) with the father of the first child	Not in a relationship with the father of the first child
Income	Gross income of the household where the adolescent is from	NA
Intending to become pregnant again	Intending to be pregnant again	Not intending to be pregnant again
Living with at least 1 parent/kin	Living with the parents or at least 1 kin	Not living with parent or kin
Living with partner	Living with the partner in same household	Not living with the partner in same household
Locus of control	Locus of control score which comprises internal and external control	NA
Married	Married	Not married
Number of sexual partners	More than one sexual partner	No or having only 1

Predictor	Definition	Reference Group
		sexual partner
Parental monitoring	Perceived of the adolescents that they are being monitored by their parents	NA
Parity	Having more than 1 child	Has only 1 child
Partner support	Having a supportive partner in terms of emotional support and childcare support	Not supportive
Partner-adolescent age difference	Difference between the age of the adolescent and her current partner (per year)	NA
Peers are teen mothers	Have peers who are also teenage mother	Have no peers who are teen mothers
Planned first pregnancy	Their first pregnancy is planned or intended	Their first pregnancy is not planned
Presence of multiple risk factors	Has at least 6 risk factors	Has less than 6 risk factors
Race	Being part of minority (Black, Hispanic or indigenous)	Being a White or majority class
Received insurance or subsidy	Has medical insurance or receiving cash incentive	Not receiving any insurance or incentive
Religion	Being a Roman Catholic	Being a non-Roman Catholic
Religious involvement	Frequent attendance to religious event	Not attending or occasional attendance to religious event
School drop-out	Stopped studying/attending school	Still attending school
School expulsion/suspension	Ever had school problems/suspension or expelled	Never had problems in school related to violence, etc.
School performance	At least average performance in school courses (e.g. math, reading)	Below average performance
Self-esteem	Self-esteem score using as scale	NA
Smoking	Currently smoking	Not smoking
Support from adolescent's mother	Score calculated using the positive social support (e.g. child care) received by the adolescent from their mother	
Use of contraception	Using any type of contraception	Not using any type of contraception
Use of LARC immediate postpartum	Using long acting reversible contraceptives (e.g. implants, IUD)	Not using any contraceptives or using non-LARC
Violence	Been arrested, jailed or involved in fighting/hitting other or any violent behaviour	Did not exhibit violent behavior

*NA-Not applicable because continuous variable

Table S. 7. Complete search strategy
EMBASE

No.	Query	Results
#7	'factors' OR 'factor' OR 'determinants' OR 'determinant' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'cause' OR 'causes' OR 'reasons' OR 'origin' OR 'correlates' AND ('teen pregnancy' OR 'teenage pregnancy'/exp OR 'teenage pregnancy' OR 'adolescent pregnancy'/exp OR 'adolescent pregnancy' OR 'teen birth' OR 'teenage birth' OR 'adolescent birth' OR 'teen pregnancies' OR 'teenage pregnancies' OR 'adolescent pregnancies' OR 'teen births' OR 'teenage births' OR 'adolescent births' OR 'teen childbearing' OR 'teenage childbearing' OR 'adolescent childbearing' OR 'teen conception' OR 'teenage conception' OR 'adolescent conception') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'second' OR 'secondary' OR 'recurrent' OR 'recurrence' OR 'succeeding' OR 'next') NOT (outcome* OR cancer OR program*)	468
#6	'factors' OR 'factor' OR 'determinants' OR 'determinant' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'cause' OR 'causes' OR 'reasons' OR 'origin' OR 'correlates' AND ('teen pregnancy' OR 'teenage pregnancy'/exp OR 'teenage pregnancy' OR 'adolescent pregnancy'/exp OR 'adolescent pregnancy' OR 'teen birth' OR 'teenage birth' OR 'adolescent birth' OR 'teen pregnancies' OR 'teenage pregnancies' OR 'adolescent pregnancies' OR 'teen births' OR 'teenage births' OR 'adolescent births' OR 'teen childbearing' OR 'teenage childbearing' OR 'adolescent childbearing' OR 'teen conception' OR 'teenage conception' OR 'adolescent conception') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'second' OR 'secondary' OR 'recurrent' OR 'recurrence' OR 'succeeding' OR 'next')	1003
#5	'teen pregnancy' OR 'teenage pregnancy'/exp OR 'teenage pregnancy' OR 'adolescent pregnancy'/exp OR 'adolescent pregnancy' OR 'teen birth' OR 'teenage birth' OR 'adolescent birth' OR 'teen pregnancies' OR 'teenage pregnancies' OR 'adolescent pregnancies' OR 'teen births' OR 'teenage births' OR 'adolescent births' OR 'teen childbearing' OR 'teenage childbearing' OR 'adolescent childbearing' OR 'teen conception' OR 'teenage conception' OR 'adolescent conception' AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'second' OR 'secondary' OR 'recurrent' OR 'recurrence' OR 'succeeding' OR 'next')	1460
#4	outcome* OR cancer OR program*	5626255
#3	'factors' OR 'factor' OR 'determinants' OR 'determinant' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'cause' OR 'causes' OR 'reasons' OR 'origin' OR 'correlates'	6876610
#2	'repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'second' OR 'secondary' OR 'recurrent' OR 'recurrence' OR 'succeeding' OR 'next'	4254243
#1	'teen pregnancy' OR 'teenage pregnancy'/exp OR 'teenage pregnancy' OR 'adolescent pregnancy'/exp OR 'adolescent pregnancy' OR 'teen birth' OR 'teenage birth' OR 'adolescent birth' OR 'teen pregnancies' OR 'teenage pregnancies' OR 'adolescent pregnancies' OR 'teen births' OR 'teenage births' OR 'adolescent births' OR 'teen childbearing' OR 'teenage childbearing' OR 'adolescent childbearing' OR 'teen conception' OR 'teenage conception' OR 'adolescent conception'	9040

CINAHL

#	Query	Results
S10	S7 NOT (outcome* OR cancer OR program*)	637
S9	'teenage pregnancy'/exp OR 'teenage pregnancy' OR 'teenage birth' OR 'teenage pregnancies' OR 'teenage births' OR 'adolescent birth' OR 'adolescent births' OR 'adolescent pregnancies' OR 'adolescent pregnancy'/exp OR 'adolescent pregnancy' AND ('factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR 'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another')	7,674
S8	S7 NOT S5	1,357
S7	S4 AND S6	1,357
S6	S2 AND S3	1,662
S5	outcome* OR cancer OR program*	871
S4	"factors" OR "factor" OR "determinants" OR "determinant" OR "predictor" OR "predictors" OR "risks" OR "risk" OR "cause" OR "causes" OR "reasons" OR "origin" OR "correlates"	7,173,031
S3	"Repeat" OR "repeated" OR "repeats" OR "subsequent" OR "multiple" OR "second" OR "secondary" OR "recurrent" OR "recurrence" OR "succeeding" OR "next"	3,806,608
S2	"teen pregnancy" OR "teenage pregnancy" OR "adolescent pregnancy" OR "teen birth" OR "teenage birth" OR "adolescent birth" OR "teen pregnancies" OR "teenage pregnancies" OR "adolescent pregnancies" OR "teen births" OR "teenage births" OR "adolescent births" OR "teen childbearing" OR "teenage childbearing" OR "adolescent childbearing" OR "teen conception" OR "teenage conception" OR "adolescent conception"	8,511
S1	'teenage pregnancy'/exp OR 'teenage pregnancy' OR 'teenage birth' OR 'teenage pregnancies' OR 'teenage births' OR 'adolescent birth' OR 'adolescent births' OR 'adolescent pregnancies' OR 'adolescent pregnancy'/exp OR 'adolescent pregnancy'	8,732

PubMed
September 21, 2015

Search	Query	Items found
#47	Search ((((((((((((repeat) OR repeated) OR subsequent) OR "secondary") OR "second") OR recurrent) OR reccurrence) OR next)) AND (((((((((pregnancy) OR pregnancies) OR birth) OR births) OR childbearing) OR conception)) AND ((((((((((teen) OR teenage) OR teens) OR adolescent) OR adolescents) OR young) OR "young mother") OR "young mothers") OR "young moms") OR "young mom"))) OR (((((((((repeat) OR repeated) OR subsequent) OR multiple) OR another) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ((((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))))) AND ((((((((factors) OR predictors) OR determinants) OR causes) OR reasons) OR risks) OR origins) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat])))) NOT outcomes Sort by: [relevance]	13204
#46	Search (((((((((((((repeat) OR repeated) OR subsequent) OR "secondary") OR "second") OR recurrent) OR reccurrence) OR next)) AND (((((((((pregnancy) OR pregnancies) OR birth) OR births) OR childbearing) OR conception)) AND ((((((((((teen) OR teenage) OR teens) OR adolescent) OR adolescents) OR young) OR "young mother") OR "young mothers") OR "young moms") OR "young mom"))) OR (((((((((repeat) OR repeated) OR subsequent) OR multiple) OR another) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ((((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))))) AND ((((((((factors) OR predictors) OR determinants) OR causes) OR reasons) OR risks) OR origins) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat])))) NOT outcomes)	13204
#37	Search (((((((((((repeat) OR repeated) OR subsequent) OR secondary) OR second) OR recurrent) OR reccurrence) OR next)) AND (((((((((pregnancy) OR pregnancies) OR birth) OR births) OR childbearing) OR conception)) AND ((((((((((teen) OR teenage) OR teens) OR adolescent) OR adolescents) OR young) OR "young mother") OR "young mothers") OR "young moms") OR "young mom"))) OR (((((((((repeat) OR repeated) OR subsequent) OR multiple) OR another) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ((((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))))) AND ((((((((factors) OR predictors) OR determinants) OR causes) OR reasons) OR risks) OR origins) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat])) Sort by: [relevance]	15329
#45	Search ((((((((((((((repeat) OR repeated) OR subsequent) OR secondary) OR second) OR recurrent) OR reccurrence) OR next)) AND (((((((((pregnancy) OR pregnancies) OR birth) OR births) OR childbearing) OR conception)) AND ((((((((((teen) OR teenage) OR teens) OR adolescent) OR adolescents) OR young) OR "young mother") OR "young	0

Search	Query	Items found
	mothers") OR "young moms") OR "young mom"))) OR (((((((((repeat) OR repeated) OR subsequent) OR multiple) OR another) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND (((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))))) AND ((((((((factors) OR predictors) OR determinants) OR causes) OR reasons) OR risks) OR origins) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat])))) NOT outcomes) [Tiab]) Schema: all Sort by: [relevance]	
#44	Search ((((((((((((((repeat) OR repeated) OR subsequent) OR secondary) OR second) OR recurrent) OR reccurrence) OR next)) AND (((((((((pregnancy) OR pregnancies) OR birth) OR births) OR childbearing) OR conception)) AND (((((((((teen) OR teenage) OR teens) OR adolescent) OR adolescents) OR young) OR "young mother") OR "young mothers") OR "young moms") OR "young mom"))) OR (((((((((repeat) OR repeated) OR subsequent) OR multiple) OR another) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND (((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))))) AND ((((((((factors) OR predictors) OR determinants) OR causes) OR reasons) OR risks) OR origins) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat])))) NOT outcomes) [Tiab]) Sort by: [relevance]	0
#43	Search ((((((((((repeat[All Fields] OR repeated[All Fields]) OR subsequent[All Fields]) OR ("secondary"[Subheading] OR "secondary"[All Fields] OR "neoplasm metastasis"[MeSH Terms] OR ("neoplasm"[All Fields] AND "metastasis"[All Fields]) OR "neoplasm metastasis"[All Fields])) OR second[All Fields]) OR recurrent[All Fields]) OR reccurrence[All Fields]) OR next[All Fields]) AND (((((((("pregnancy"[MeSH Terms] OR "pregnancy"[All Fields]) OR ("pregnancy"[MeSH Terms] OR "pregnancy"[All Fields] OR "pregnancies"[All Fields])) OR ("parturition"[MeSH Terms] OR "parturition"[All Fields] OR "birth"[All Fields])) OR ("parturition"[MeSH Terms] OR "parturition"[All Fields] OR "births"[All Fields])) OR childbearing[All Fields]) OR ("fertilization"[MeSH Terms] OR "fertilization"[All Fields] OR "conception"[All Fields])) AND ((((((((("adolescent"[MeSH Terms] OR "adolescent"[All Fields] OR "teen"[All Fields]) OR ("adolescent"[MeSH Terms] OR "adolescent"[All Fields] OR "teenage"[All Fields])) OR ("adolescent"[MeSH Terms] OR "adolescent"[All Fields] OR "teens"[All Fields])) OR ("adolescent"[MeSH Terms] OR "adolescent"[All Fields])) OR ("adolescent"[MeSH Terms] OR "adolescent"[All Fields] OR "adolescents"[All Fields])) OR young[All Fields]) OR "young mother"[All Fields]) OR "young mothers"[All Fields]) OR (young[All Fields] AND moms[All Fields])) OR (young[All Fields] AND mom[All Fields]))) OR ((((((repeat[All Fields] OR repeated[All Fields]) OR subsequent[All Fields]) OR multiple[All Fields]) AND ("1980/01/01"[PDAT] : "3000/12/31"[PDAT])) AND (((((((("teenage pregnancy"[All Fields] OR "teenage birth"[All Fields]) OR "teenage pregnancies"[All Fields]) OR "teenage births"[All Fields]) OR (adolesent[All Fields] AND ("parturition"[MeSH Terms] OR "parturition"[All Fields] OR "birth"[All Fields]))) OR "adolescent births"[All Fields]) OR "adolescent pregnancies"[All Fields]) OR "adolescent pregnancy"[All Fields]) AND ("1980/01/01"[PDAT] : "3000/12/31"[PDAT]))) AND ("1980/01/01"[PDAT] : "3000/12/31"[PDAT])))) AND (((((((factors[All Fields] OR predictors[All Fields]) OR	0

Search	Query	Items found
	determinants[All Fields]) OR ("etiology"[Subheading] OR "etiology"[All Fields] OR "causes"[All Fields] OR "causality"[MeSH Terms] OR "causality"[All Fields])) OR reasons[All Fields]) OR ("risk"[MeSH Terms] OR "risk"[All Fields] OR "risks"[All Fields])) OR ("Origins"[Journal] OR "origins"[All Fields])) AND ("1980/01/01"[PDAT] : "3000/12/31"[PDAT]))) NOT outcomes[All Fields] [Tiab])	
#42	Search (((((((((repeat[All Fields] OR repeated[All Fields]) OR subsequent[All Fields]) OR ("secondary"[Subheading] OR "secondary"[All Fields] OR "neoplasm metastasis"[MeSH Terms] OR ("neoplasm"[All Fields] AND "metastasis"[All Fields]) OR "neoplasm metastasis"[All Fields])) OR second[All Fields]) OR recurrent[All Fields]) OR reccurrence[All Fields]) OR next[All Fields]) AND ((((((("pregnancy"[MeSH Terms] OR "pregnancy"[All Fields]) OR ("pregnancy"[MeSH Terms] OR "pregnancy"[All Fields] OR "pregnancies"[All Fields])) OR ("parturition"[MeSH Terms] OR "parturition"[All Fields] OR "birth"[All Fields])) OR ("parturition"[MeSH Terms] OR "parturition"[All Fields] OR "births"[All Fields])) OR childbearing[All Fields]) OR ("fertilization"[MeSH Terms] OR "fertilization"[All Fields] OR "conception"[All Fields])) AND ((((((((("adolescent"[MeSH Terms] OR "adolescent"[All Fields] OR "teen"[All Fields]) OR ("adolescent"[MeSH Terms] OR "adolescent"[All Fields] OR "teenage"[All Fields])) OR ("adolescent"[MeSH Terms] OR "adolescent"[All Fields] OR "teens"[All Fields])) OR ("adolescent"[MeSH Terms] OR "adolescent"[All Fields])) OR ("adolescent"[MeSH Terms] OR "adolescent"[All Fields] OR "adolescents"[All Fields])) OR young[All Fields]) OR "young mother"[All Fields]) OR "young mothers"[All Fields]) OR (young[All Fields] AND moms[All Fields])) OR (young[All Fields] AND mom[All Fields]))) OR ((((((repeat[All Fields] OR repeated[All Fields]) OR subsequent[All Fields]) OR multiple[All Fields]) AND ("1980/01/01"[PDAT] : "3000/12/31"[PDAT])) AND (((((((("teenage pregnancy"[All Fields] OR "teenage birth"[All Fields]) OR "teenage pregnancies"[All Fields]) OR "teenage births"[All Fields]) OR (adolesent[All Fields] AND ("parturition"[MeSH Terms] OR "parturition"[All Fields] OR "birth"[All Fields]))) OR "adolescent births"[All Fields]) OR "adolescent pregnancies"[All Fields]) OR "adolescent pregnancy"[All Fields]) AND ("1980/01/01"[PDAT] : "3000/12/31"[PDAT]))) AND ("1980/01/01"[PDAT] : "3000/12/31"[PDAT])))) AND (((((((factors[All Fields] OR predictors[All Fields]) OR determinants[All Fields]) OR ("etiology"[Subheading] OR "etiology"[All Fields] OR "causes"[All Fields] OR "causality"[MeSH Terms] OR "causality"[All Fields])) OR reasons[All Fields]) OR ("risk"[MeSH Terms] OR "risk"[All Fields] OR "risks"[All Fields])) OR ("Origins"[Journal] OR "origins"[All Fields])) AND ("1980/01/01"[PDAT] : "3000/12/31"[PDAT]))) NOT outcomes[All Fields] Sort by: [relevance]	13281
#39	Search ((((((((((((repeat) OR repeated) OR subsequent) OR secondary) OR second) OR recurrent) OR reccurrence) OR next)) AND ((((((((((pregnancy) OR pregnancies) OR birth) OR births) OR childbearing) OR conception)) AND ((((((((((teen) OR teenage) OR teens) OR adolescent) OR adolescents) OR young) OR "young mother") OR "young mothers") OR "young moms") OR "young mom"))) OR (((((((((repeat) OR repeated) OR subsequent) OR multiple) OR another) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ((((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ("1980/01/01"[PDat]	13281

Search	Query	Items found
	: "3000/12/31"[PDat]))))) AND ((((((((factors) OR predictors) OR determinants) OR causes) OR reasons) OR risks) OR origins) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat])))) NOT outcomes Sort by: [relevance]	
#41	Search ((((((((((((((repeat) OR repeated) OR subsequent) OR secondary) OR second) OR recurrent) OR reccurrence) OR next)) AND (((((((((pregnancy) OR pregnancies) OR birth) OR births) OR childbearing) OR conception)) AND ((((((((((teen) OR teenage) OR teens) OR adolescent) OR adolescents) OR young) OR "young mother") OR "young mothers") OR "young moms") OR "young mom"))) OR (((((((((repeat) OR repeated) OR subsequent) OR multiple) OR another) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND (((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))))) AND ((((((((factors) OR predictors) OR determinants) OR causes) OR reasons) OR risks) OR origins) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat])))) NOT outcomes)) AND [tiab]	0
#40	Search ((((((((((((repeat) OR repeated) OR subsequent) OR secondary) OR second) OR recurrent) OR reccurrence) OR next)) AND (((((((((pregnancy) OR pregnancies) OR birth) OR births) OR childbearing) OR conception)) AND ((((((((((teen) OR teenage) OR teens) OR adolescent) OR adolescents) OR young) OR "young mother") OR "young mothers") OR "young moms") OR "young mom"))) OR (((((((((repeat) OR repeated) OR subsequent) OR multiple) OR another) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND (((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))))) AND ((((((((factors) OR predictors) OR determinants) OR causes) OR reasons) OR risks) OR origins) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat])))) NOT outcomes Filters: Abstract Sort by: [relevance]	13131
#38	Search ((((((((((((repeat) OR repeated) OR subsequent) OR secondary) OR second) OR recurrent) OR reccurrence) OR next)) AND (((((((((pregnancy) OR pregnancies) OR birth) OR births) OR childbearing) OR conception)) AND ((((((((((teen) OR teenage) OR teens) OR adolescent) OR adolescents) OR young) OR "young mother") OR "young mothers") OR "young moms") OR "young mom"))) OR (((((((((repeat) OR repeated) OR subsequent) OR multiple) OR another) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND (((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))))) AND ((((((((factors) OR predictors) OR determinants) OR causes) OR reasons) OR risks) OR origins) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat])))) OR outcomes	533371
#36	Search (((((((((repeat) OR repeated) OR subsequent) OR secondary) OR second) OR recurrent) OR reccurrence) OR next)) AND (((((((((pregnancy) OR pregnancies) OR birth) OR births) OR childbearing) OR conception)) AND ((((((((((teen) OR teenage) OR teens) OR adolescent) OR adolescents) OR young) OR "young mother") OR "young mothers") OR "young moms") OR "young mom"))) OR (((((((((repeat) OR repeated) OR subsequent) OR multiple) OR	21812

Search	Query	Items found
	another) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND (((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat])))	
#35	Search (((((((repeat) OR repeated) OR subsequent) OR secondary) OR second) OR recurrent) OR reccurrence) OR next	2530798
#34	Search (((((((((pregnancy) OR pregnancies) OR birth) OR births) OR childbearing) OR conception)) AND ((((((((((teen) OR teenage) OR teens) OR adolescent) OR adolescents) OR young) OR "young mother") OR "young mothers") OR "young moms") OR "young mom"))) OR (((((((((repeat) OR repeated) OR subsequent) OR multiple) OR another) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND (((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))	133634
#33	Search (((((((pregnancy) OR pregnancies) OR birth) OR births) OR childbearing) OR conception)) AND ((((((((((teen) OR teenage) OR teens) OR adolescent) OR adolescents) OR young) OR "young mother") OR "young mothers") OR "young moms") OR "young mom")	133634
#32	Search (((((pregnancy) OR pregnancies) OR birth) OR births) OR childbearing) OR conception	1028886
#31	Search ((((((((teen) OR teenage) OR teens) OR adolescent) OR adolescents) OR young) OR "young mother") OR "young mothers") OR "young moms") OR "young mom"	2226854
#30	Search ((((((((factors) OR predictors) OR determinants) OR causes) OR reasons) OR risks) OR origins) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND (((((((((((mother*) OR mom) OR parent*)) OR moms)) AND ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) OR ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) AND ((((((((((((((child) OR children) OR kids) OR kid) OR deliver*) OR birth*) OR infant*) OR baby) OR babies) OR offspring*)) OR ((((((pregnant) OR pregnancy) OR gravid*) OR conception*) OR childbearing) OR pregnancies))) AND ((((((((((((((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next)))	174718
#29	Search (((((((((((mother*) OR mom) OR parent*)) OR moms)) AND ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) OR ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) AND ((((((((((((((child) OR children) OR kids) OR kid) OR deliver*) OR birth*) OR infant*) OR baby) OR babies) OR offspring*)) OR ((((((pregnant) OR pregnancy) OR gravid*) OR conception*) OR childbearing) OR pregnancies))) AND ((((((((((((((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next))	270301

Search	Query	Items found
#14	Search ((((((((mother*) OR mom) OR parent*)) OR moms)) AND ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) OR ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*)	2450512
#16	Search (((((((((((((child) OR children) OR kids) OR kid) OR deliver*) OR birth*) OR infant*) OR baby) OR babies) OR offspring*)) OR ((((((pregnant) OR pregnancy) OR gravid*) OR conception*) OR childbearing) OR pregnancies))) AND (((((((((((((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next)	807748
#28	Search ((((((factors) OR predictors) OR determinants) OR causes) OR reasons) OR risks) OR origins Filters: Publication date from 1980/01/01	9059518
#24	Search (((((((repeat) OR repeated) OR subsequent) OR multiple) OR another) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND (((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat])) Filters: Publication date from 1980/01/01	467
#27	Search ((((((((((repeat) OR repeated) OR subsequent) OR multiple) OR another) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND (((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND (factors OR predictors OR determinants) Filters: Publication date from 1980/01/01	353
#26	Search ((((((((((repeat) OR repeated) OR subsequent) OR multiple) OR another) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND (((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) OR ((((((((((((((((((child) OR children) OR kids) OR kid) OR deliver*) OR birth*) OR infant*) OR baby) OR babies) OR offspring*)) OR ((((((pregnant) OR pregnancy) OR gravid*) OR conception*) OR childbearing) OR pregnancies))) AND (((((((((((((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next))) AND (((((((((mother*) OR mom) OR parent*)) OR moms)) AND ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) OR ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*)))) AND ((((((((((((factor*) OR predictor*) OR risk) OR cause*) OR reason*) OR dynamic*) OR influence*) OR origin*) OR basis) OR bases)) OR risks)) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat])) Filters: Publication date from 1980/01/01	152444
#25	Search ((((((((((repeat) OR repeated) OR subsequent) OR multiple) OR another) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND (((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage	421

Search	Query	Items found
	births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ((((((((((((((((((child) OR children) OR kids) OR kid) OR deliver*) OR birth*) OR infant*) OR baby) OR babies) OR offspring*)) OR ((((((pregnant) OR pregnancy) OR gravid*) OR conception*) OR childbearing) OR pregnancies))) AND (((((((((((((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next))) AND (((((((((mother*) OR mom) OR parent*)) OR moms)) AND ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) OR ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*)))) AND ((((((((((((factor*) OR predictor*) OR risk) OR cause*) OR reason*) OR dynamic*) OR influence*) OR origin*) OR basis) OR bases)) OR risks)) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat])) Filters: Publication date from 1980/01/01	
#23	Search ((((repeat) OR repeated) OR subsequent) OR multiple) OR another Filters: Publication date from 1980/01/01	1593631
#21	Search ((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy" Filters: Publication date from 1980/01/01	3531
#22	Search ((((((((((((((((((child) OR children) OR kids) OR kid) OR deliver*) OR birth*) OR infant*) OR baby) OR babies) OR offspring*)) OR ((((((pregnant) OR pregnancy) OR gravid*) OR conception*) OR childbearing) OR pregnancies))) AND (((((((((((((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next))) AND (((((((((mother*) OR mom) OR parent*)) OR moms)) AND ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) OR ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*)))) AND ((((((((((((factor*) OR predictor*) OR risk) OR cause*) OR reason*) OR dynamic*) OR influence*) OR origin*) OR basis) OR bases)) OR risks)) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ((((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat])) Filters: Publication date from 1980/01/01	1152
#20	Search ((((((((((((((((((child) OR children) OR kids) OR kid) OR delivery) OR birth*) OR infant*) OR baby) OR babies) OR offspring)) OR ((((((pregnant) OR pregnancy) OR gravid) OR conception*) OR childbearing) OR pregnancies))) AND (((((((((((((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next))) AND (((((((((mother*) OR mom) OR parent*)) OR moms)) AND ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) OR ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*)))) AND ((((((((((((factor*) OR predictor*) OR risk) OR cause*) OR reason*) OR dynamic*) OR	150717

Search	Query	Items found
	influence*) OR origin*) OR basis) OR bases)) OR risks)) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat])) Filters: Publication date from 1980/01/01 Sort by: [relevance]	
#19	Search ((((((((((((((((child) OR children) OR kids) OR kid) OR deliver*) OR birth*) OR infant*) OR baby) OR babies) OR offspring*)) OR ((((((pregnant) OR pregnancy) OR gravid*) OR conception*) OR childbearing) OR pregnancies))) AND (((((((((((((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next))) AND (((((((((mother*) OR mom) OR parent*)) OR moms)) AND ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) OR ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*)))) AND (((((((((((factor*) OR predictor*) OR risk) OR cause*) OR reason*) OR dynamic*) OR influence*) OR origin*) OR basis) OR bases)) OR risks) Filters: Publication date from 1980/01/01 Sort by: [relevance]	152398
#18	Search ((((((((((((((((child) OR children) OR kids) OR kid) OR deliver*) OR birth*) OR infant*) OR baby) OR babies) OR offspring*)) OR ((((((pregnant) OR pregnancy) OR gravid*) OR conception*) OR childbearing) OR pregnancies))) AND (((((((((((((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next))) AND (((((((((mother*) OR mom) OR parent*)) OR moms)) AND ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) OR ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*)))) AND (((((((((((factor*) OR predictor*) OR risk) OR cause*) OR reason*) OR dynamic*) OR influence*) OR origin*) OR basis) OR bases)) OR risks) Sort by: [relevance]	159011
#17	Search ((((((((((((((child) OR children) OR kids) OR kid) OR deliver*) OR birth*) OR infant*) OR baby) OR babies) OR offspring*)) OR ((((((pregnant) OR pregnancy) OR gravid*) OR conception*) OR childbearing) OR pregnancies))) AND (((((((((((((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next))) AND (((((((((mother*) OR mom) OR parent*)) OR moms)) AND ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) OR ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))	270301
#15	Search ((((((((((child) OR children) OR kids) OR kid) OR deliver*) OR birth*) OR infant*) OR baby) OR babies) OR offspring*)) OR ((((((pregnant) OR pregnancy) OR gravid*) OR conception*) OR childbearing) OR pregnancies)	3583139
#13	Search ((((((mother*) OR mom) OR parent*)) OR moms)) AND ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*)	138835
#12	Search ((((mother*) OR mom) OR parent*)) OR moms Sort by: [relevance]	542042
#11	Search (((((((((((factor*) OR predictor*) OR risk) OR cause*) OR reason*) OR dynamic*) OR influence*) OR origin*) OR basis) OR bases)) OR risks	8251640
#9	Search ((((((((((((((factor*) OR predictor*) OR risk*) OR cause*) OR reason*) OR dynamic*) OR influence*) OR origin*)	16434

Search	Query	Items found
	OR basis) OR bases)) AND (((((((mother*) OR mom*) OR parent*)) AND ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) OR ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) AND ((((((((((((((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next)) AND ((((((pregnant) OR pregnancy) OR gravid*) OR conception*) OR childbearing) OR pregnancies)) AND ((((((((((child) OR children) OR kids) OR kid) OR deliver*) OR birth*) OR infant*) OR baby) OR babies) OR offspring*) Sort by: [relevance]	
#8	Search (((((((((child) OR children) OR kids) OR kid) OR deliver*) OR birth*) OR infant*) OR baby) OR babies) OR offspring*	3081902
#7	Search (((((pregnant) OR pregnancy) OR gravid*) OR conception*) OR childbearing) OR pregnancies	853166
#6	Search (((((((((((((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next	4758129
#5	Search ((((((mother*) OR mom*) OR parent*)) AND ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) OR ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*)	2450512
#4	Search ((((mother*) OR mom*) OR parent*)) AND ((((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*)	146648
#3	Search ((mother*) OR mom*) OR parent*	615928
#2	Search (((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*	2450512
#1	Search (((((((((factor*) OR predictor*) OR risk*) OR cause*) OR reason*) OR dynamic*) OR influence*) OR origin*) OR basis) OR bases	8197876

September 25, 2015

Search	Query	Items found
#27	Search ((((((repeat* [tiab]) OR subsequent [tiab]) OR [multiple]) OR second* [tiab]) OR recurren* [tiab])) AND (((((((pregnant OR pregnancy OR conception OR childbearing OR pregnancies OR birth OR births))) AND (((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next))) AND (((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) AND ((((mother*) OR mom OR moms) OR parent*))))) OR (((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))))) AND (Â outcome*Â ORÂ cancerÂ ORÂ program*Â))	707038

Search	Query	Items found
#26	Search ((((repeat* [tiab]) OR subsequent [tiab]) OR [multiple]) OR second* [tiab]) OR recurren* [tiab]	3142320
#25	Search causes of back pain Sort by: [relevance]	22564
#24	Search (((((pregnant OR pregnancy OR conception OR childbearing OR pregnancies OR birth OR births))) AND (((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next))) AND (((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) AND ((((mother*) OR mom OR moms) OR parent*))))) OR (((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) [Tiab])	11
#23	Search (((((pregnant OR pregnancy OR conception OR childbearing OR pregnancies OR birth OR births))) AND (((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next))) AND (((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) AND ((((mother*) OR mom OR moms) OR parent*))))) OR (((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) [Tiab})	11
#22	Search ((((((pregnant OR pregnancy OR conception OR childbearing OR pregnancies OR birth OR births))) AND (((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next))) AND (((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) AND ((((mother*) OR mom OR moms) OR parent*))))) OR (((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))))) AND (Â outcome*Â ORÂ cancerÂ ORÂ program*Â)	707038
#21	Search (((((pregnant OR pregnancy OR conception OR childbearing OR pregnancies OR birth OR births))) AND (((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next))) AND (((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) AND ((((mother*) OR mom OR moms) OR parent*))))) OR (((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) [tiab])	11
#20	Search ((((pregnant OR pregnancy OR conception OR childbearing OR pregnancies OR birth OR births))) AND (((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next))) AND (((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) AND ((((mother*) OR mom OR moms) OR parent*))))) OR (((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*)))	2452015
#19	Search (pregnant OR pregnancy OR conception OR childbearing OR pregnancies OR birth OR births)	1043780

Search	Query	Items found
#18	Search ((repeat*) OR subsequen*) OR secondary) OR second) OR multiple) OR many) OR several) OR another) OR recurrence) OR recurrent) OR again) OR succeed*) OR later) OR next)	4761258
#17	Search ((((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) AND ((((mother*) OR mom OR moms) OR parent*))))) OR (((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))	2452015
#16	Search ((((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*))) AND ((((mother*) OR mom OR moms) OR parent*)))	138930
#15	Search (((mother*) OR mom OR moms) OR parent*))	542325
#14	Search ((mother*) OR mom*) OR parent*)	616262
#13	Search ((teen*) OR adolescen*) OR young) OR youth) OR "under 20") OR "under twenty") OR "young adult") OR Minor*)	2452015
#9	Search (((((("factors" OR "factor" OR "determinants" OR "determinant" OR "predictor" OR "predictors" OR "risks" OR "risk" OR "cause" OR "causes" OR "reasons" OR "origin" OR "correlates"))) AND (((("Repeat" OR "repeated" OR "repeats" OR "subsequent" OR "multiple" OR "second" OR "secondary" OR "recurrent" OR "recurrence" OR "succeeding" OR "next"))) AND ((("teen pregnancy" OR "teenage pregnancy" OR "adolescent pregnancy") OR ("teen birth" OR "teenage birth" OR "adolescent birth") OR ("teen pregnancies" OR "teenage pregnancies" OR "adolescent pregnancies") OR ("teen births" OR "teenage births" OR "adolescent births") OR ("teen childbearing" OR "teenage childbearing" OR "adolescent childbearing") OR ("teen conception" OR "teenage conception" OR "adolescent conception")))))) NOT (Â outcome*Â ORÂ cancerÂ ORÂ program*Â)	567
#8	Search ((("factors" OR "factor" OR "determinants" OR "determinant" OR "predictor" OR "predictors" OR "risks" OR "risk" OR "cause" OR "causes" OR "reasons" OR "origin" OR "correlates"))) AND (((("Repeat" OR "repeated" OR "repeats" OR "subsequent" OR "multiple" OR "second" OR "secondary" OR "recurrent" OR "recurrence" OR "succeeding" OR "next"))) AND ((("teen pregnancy" OR "teenage pregnancy" OR "adolescent pregnancy") OR ("teen birth" OR "teenage birth" OR "adolescent birth") OR ("teen pregnancies" OR "teenage pregnancies" OR "adolescent pregnancies") OR ("teen births" OR "teenage births" OR "adolescent births") OR ("teen childbearing" OR "teenage childbearing" OR "adolescent childbearing") OR ("teen conception" OR "teenage conception" OR "adolescent conception"))))	1287
#7	Search ((("Repeat" OR "repeated" OR "repeats" OR "subsequent" OR "multiple" OR "second" OR "secondary" OR "recurrent" OR "recurrence" OR "succeeding" OR "next"))) AND ((("teen pregnancy" OR "teenage pregnancy" OR "adolescent pregnancy") OR ("teen birth" OR "teenage birth" OR "adolescent birth") OR ("teen pregnancies" OR "teenage pregnancies" OR "adolescent pregnancies") OR ("teen births" OR "teenage births" OR "adolescent births") OR ("teen childbearing" OR "teenage childbearing" OR "adolescent childbearing") OR ("teen conception" OR "teenage conception" OR "adolescent conception")))	1685
#6	Search (Â outcome*Â ORÂ cancerÂ ORÂ program*Â)	5192896

Search	Query	Items found
#5	Search ("factors" OR "factor" OR "determinants" OR "determinant" OR "predictor" OR "predictors" OR "risks" OR "risk" OR "cause" OR "causes" OR "reasons" OR "origin" OR "correlates")	6334875
#4	Search ("Repeat" OR "repeated" OR "repeats" OR "subsequent" OR "multiple" OR "second" OR "secondary" OR "recurrent" OR "recurrence" OR "succeeding" OR "next")	3478021
#3	Search (("teen pregnancy" OR "teenage pregnancy" OR "adolescent pregnancy") OR ("teen birth" OR "teenage birth" OR "adolescent birth") OR ("teen pregnancies" OR "teenage pregnancies" OR "adolescent pregnancies") OR ("teen births" OR "teenage births" OR "adolescent births") OR ("teen childbearing" OR "teenage childbearing" OR "adolescent childbearing") OR ("teen conception" OR "teenage conception" OR "adolescent conception"))	7107
#2	Search (((((((((((repeat) OR repeated) OR subsequent) OR secondary) OR second) OR recurrent) OR reccurrence) OR next)) AND (((((((((pregnancy) OR pregnancies) OR birth) OR births) OR childbearing) OR conception)) AND ((((((((((teen) OR teenage) OR teens) OR adolescent) OR adolescents) OR young) OR "young mother") OR "young mothers") OR "young moms") OR "young mom"))) OR (((((((((repeat) OR repeated) OR subsequent) OR multiple) OR another) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ((((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))))) AND ((((((((factors) OR predictors) OR determinants) OR causes) OR reasons) OR risks) OR origins) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat])) Sort by: [relevance]	15343
#1	Search (((((((((((((repeat) OR repeated) OR subsequent) OR "secondary") OR "second") OR recurrent) OR reccurrence) OR next)) AND (((((((((pregnancy) OR pregnancies) OR birth) OR births) OR childbearing) OR conception)) AND ((((((((((teen) OR teenage) OR teens) OR adolescent) OR adolescents) OR young) OR "young mother") OR "young mothers") OR "young moms") OR "young mom"))) OR (((((((((repeat) OR repeated) OR subsequent) OR multiple) OR another) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ((((((((("teenage pregnancy") OR "teenage birth") OR "teenage pregnancies") OR "teenage births") OR "adolesent birth") OR "adolescent births") OR "adolescent pregnancies") OR "adolescent pregnancy") AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat]))))) AND ((((((((factors) OR predictors) OR determinants) OR causes) OR reasons) OR risks) OR origins) AND ("1980/01/01"[PDat] : "3000/12/31"[PDat])))) NOT outcomes Sort by: [relevance]	13215

Scopus

	Terms	Number of Studies
10	((("factors" OR "factor" OR "determinants" OR "determinant" OR "predictor" OR "predictors" OR "risks" OR "risk" OR "cause" OR "causes" OR "reasons" OR "origin" OR "correlates") AND ((("teen pregnancy" OR "teenage pregnancy" OR "adolescent pregnancy") OR ("teen birth" OR "teenage birth" OR "adolescent birth") OR ("teen pregnancies" OR "teenage pregnancies" OR "adolescent pregnancies") OR ("teen births" OR "teenage births" OR "adolescent births") OR ("teen childbearing" OR "teenage childbearing" OR "adolescent childbearing") OR ("teen conception" OR "teenage conception" OR "adolescent conception")) AND ("Repeat" OR "repeated" OR "repeats" OR "subsequent" OR "multiple" OR "second" OR "secondary" OR "recurrent" OR "recurrence" OR "succeeding" OR "next"))) AND NOT ((outcome* OR cancer OR program*))) AND ((TITLE-ABS-KEY ("Repeat" OR "repeated" OR "repeats" OR "subsequent" OR "multiple" OR "second" OR "secondary" OR "recurrent" OR "recurrence" OR "succeeding" OR "next")))	897 document results
9	(TITLE-ABS-KEY ("Repeat" OR "repeated" OR "repeats" OR "subsequent" OR "multiple" OR "second" OR "secondary" OR "recurrent" OR "recurrence" OR "succeeding" OR "next"))	7,058,523 document results
8	History Search Terms #7 AND (TITLE-ABS-KEY ("Repeat" OR "repeated" OR "repeats" OR "subsequent" OR "multiple" OR "second" OR "secondary" OR "recurrent" OR "recurrence" OR "succeeding" OR "next"))	2,153,111 document results
7	(("factors" OR "factor" OR "determinants" OR "determinant" OR "predictor" OR "predictors" OR "risks" OR "risk" OR "cause" OR "causes" OR "reasons" OR "origin" OR "correlates") AND ((("teen pregnancy" OR "teenage pregnancy" OR "adolescent pregnancy") OR ("teen birth" OR "teenage birth" OR "adolescent birth") OR ("teen pregnancies" OR "teenage pregnancies" OR "adolescent pregnancies") OR ("teen births" OR "teenage births" OR "adolescent births") OR ("teen childbearing" OR "teenage childbearing" OR "adolescent childbearing") OR ("teen conception" OR "teenage conception" OR "adolescent conception")) AND ("Repeat" OR "repeated" OR "repeats" OR "subsequent" OR "multiple" OR "second" OR "secondary" OR "recurrent" OR "recurrence" OR "succeeding" OR "next"))) AND NOT ((outcome* OR cancer OR program*))	1,878 document results
6	History Search Terms (outcome* OR cancer OR program*)	12,298,381 document results
5	("factors" OR "factor" OR "determinants" OR "determinant" OR "predictor" OR "predictors" OR "risks" OR "risk" OR "cause" OR "causes" OR "reasons" OR "origin" OR "correlates") AND ((("teen pregnancy" OR "teenage pregnancy" OR "adolescent pregnancy") OR ("teen birth" OR "teenage birth" OR "adolescent birth") OR ("teen pregnancies" OR "teenage pregnancies" OR "adolescent pregnancies") OR ("teen births" OR "teenage births" OR "adolescent births") OR ("teen childbearing" OR "teenage childbearing" OR "adolescent childbearing") OR ("teen conception" OR	10,586 document results

	Terms	Number of Studies
	"teenage conception" OR "adolescent conception")) AND ("Repeat" OR "repeated" OR "repeats" OR "subsequent" OR "multiple" OR "second" OR "secondary" OR "recurrent" OR "recurrence" OR "succeeding" OR "next"))	
4	(("teen pregnancy" OR "teenage pregnancy" OR "adolescent pregnancy") OR ("teen birth" OR "teenage birth" OR "adolescent birth") OR ("teen pregnancies" OR "teenage pregnancies" OR "adolescent pregnancies") OR ("teen births" OR "teenage births" OR "adolescent births") OR ("teen childbearing" OR "teenage childbearing" OR "adolescent childbearing") OR ("teen conception" OR "teenage conception" OR "adolescent conception")) AND ("Repeat" OR "repeated" OR "repeats" OR "subsequent" OR "multiple" OR "second" OR "secondary" OR "recurrent" OR "recurrence" OR "succeeding" OR "next")	11,388 document results
3	"factors" OR "factor" OR "determinants" OR "determinant" OR "predictor" OR "predictors" OR "risks" OR "risk" OR "cause" OR "causes" OR "reasons" OR "origin" OR "correlates"	17,718,839 document results
2	"Repeat" OR "repeated" OR "repeats" OR "subsequent" OR "multiple" OR "second" OR "secondary" OR "recurrent" OR "recurrence" OR "succeeding" OR "next"	13,190,850 document results
1	("teen pregnancy" OR "teenage pregnancy" OR "adolescent pregnancy") OR ("teen birth" OR "teenage birth" OR "adolescent birth") OR ("teen pregnancies" OR "teenage pregnancies" OR "adolescent pregnancies") OR ("teen births" OR "teenage births" OR "adolescent births") OR ("teen childbearing" OR "teenage childbearing" OR "adolescent childbearing") OR ("teen conception" OR "teenage conception" OR "adolescent conception")	25,322 document results

Web of Science

No.	Query	Results
#21	'factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR 'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason' AND ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' OR ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' AND ('mother' OR 'mothers' OR 'moms' OR 'mom' OR 'parent' OR 'parents'))) AND ('pregnancy' OR 'pregnant' OR 'conception' OR 'childbearing' OR 'birth' OR 'births' OR 'pregnancies' OR 'delivery' OR 'deliveries') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another') NOT 'outcomes' OR ('teenage pregnancy'/exp OR 'teenage pregnancy' OR 'teenage birth' OR 'teenage pregnancies' OR 'teenage births' OR 'adolescent birth' OR 'adolescent births' OR 'adolescent pregnancies' OR 'adolescent pregnancy'/exp OR 'adolescent pregnancy' AND ('factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR 'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another') NOT 'outcomes') AND ([adolescent]/lim OR [adult]/lim OR [young adult]/lim) AND (1980:py OR 1981:py OR 1982:py OR 1983:py OR 1984:py OR 1985:py OR 1986:py OR 1987:py OR 1988:py OR 1989:py OR 1990:py OR 1991:py OR 1992:py OR 1993:py OR 1994:py OR 1995:py OR 1996:py OR 1997:py OR 1998:py OR 1999:py OR 2000:py OR 2001:py OR 2002:py OR 2003:py OR 2004:py OR 2005:py OR 2006:py OR 2007:py OR 2008:py OR 2009:py OR 2010:py OR 2011:py OR 2012:py OR 2013:py OR 2014:py OR 2015:py) AND ('abortion'/de OR 'anemia'/de OR 'asthma'/de OR 'congenital malformation'/de OR 'depression'/de OR 'diabetes mellitus'/de OR 'diseases'/de OR 'high risk pregnancy'/de OR 'hypertension'/de OR 'infection'/de OR 'insulin dependent diabetes mellitus'/de OR 'maternal hypertension'/de OR 'mental disease'/de OR 'multiple pregnancy'/de OR 'obesity'/de OR 'preeclampsia'/de OR 'pregnancy complication'/de OR 'pregnancy diabetes mellitus'/de OR 'premature labor'/de OR 'prematurity'/de OR 'recurrent disease'/de OR 'spontaneous abortion'/de) AND ('diagnosis'/lnk OR 'epidemiology'/lnk OR 'etiology'/lnk OR 'prevention'/lnk)	1660
#20	'factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR 'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason' AND ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' OR ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' AND ('mother' OR 'mothers' OR 'moms' OR 'mom' OR 'parent' OR 'parents'))) AND ('pregnancy' OR 'pregnant' OR 'conception' OR 'childbearing' OR 'birth' OR 'births' OR 'pregnancies' OR 'delivery' OR 'deliveries') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another') NOT 'outcomes' OR ('teenage pregnancy'/exp OR 'teenage pregnancy' OR 'teenage birth' OR 'teenage pregnancies' OR 'teenage births' OR 'adolescent birth' OR 'adolescent births' OR 'adolescent pregnancies' OR 'adolescent pregnancy'/exp OR 'adolescent pregnancy' AND ('factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR	1781

No.	Query	Results
	'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another') NOT 'outcomes') AND ([adolescent]/lim OR [adult]/lim OR [young adult]/lim) AND (1980:py OR 1981:py OR 1982:py OR 1983:py OR 1984:py OR 1985:py OR 1986:py OR 1987:py OR 1988:py OR 1989:py OR 1990:py OR 1991:py OR 1992:py OR 1993:py OR 1994:py OR 1995:py OR 1996:py OR 1997:py OR 1998:py OR 1999:py OR 2000:py OR 2001:py OR 2002:py OR 2003:py OR 2004:py OR 2005:py OR 2006:py OR 2007:py OR 2008:py OR 2009:py OR 2010:py OR 2011:py OR 2012:py OR 2013:py OR 2014:py OR 2015:py) AND [female]/lim AND ('diagnosis'/lnk OR 'disease management'/lnk OR 'epidemiology'/lnk OR 'etiology'/lnk OR 'prevention'/lnk) AND [male]/lim	
#19	'factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR 'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason' AND ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' OR ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' AND ('mother' OR 'mothers' OR 'moms' OR 'mom' OR 'parent' OR 'parents'))) AND ('pregnancy' OR 'pregnant' OR 'conception' OR 'childbearing' OR 'birth' OR 'births' OR 'pregnancies' OR 'delivery' OR 'deliveries') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another') NOT 'outcomes' OR ('teenage pregnancy'/exp OR 'teenage pregnancy' OR 'teenage birth' OR 'teenage pregnancies' OR 'teenage births' OR 'adolescent birth' OR 'adolescent births' OR 'adolescent pregnancies' OR 'adolescent pregnancy'/exp OR 'adolescent pregnancy' AND ('factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR 'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another') NOT 'outcomes') AND ([adolescent]/lim OR [adult]/lim OR [young adult]/lim) AND (1980:py OR 1981:py OR 1982:py OR 1983:py OR 1984:py OR 1985:py OR 1986:py OR 1987:py OR 1988:py OR 1989:py OR 1990:py OR 1991:py OR 1992:py OR 1993:py OR 1994:py OR 1995:py OR 1996:py OR 1997:py OR 1998:py OR 1999:py OR 2000:py OR 2001:py OR 2002:py OR 2003:py OR 2004:py OR 2005:py OR 2006:py OR 2007:py OR 2008:py OR 2009:py OR 2010:py OR 2011:py OR 2012:py OR 2013:py OR 2014:py OR 2015:py) AND [female]/lim AND ('clinical trial'/lnk OR 'diagnosis'/lnk OR 'disease management'/lnk OR 'epidemiology'/lnk OR 'etiology'/lnk OR 'prevention'/lnk)	3914
#18	'factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR 'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason' AND ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' OR ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' AND ('mother' OR 'mothers' OR 'moms' OR 'mom' OR 'parent' OR 'parents'))) AND ('pregnancy' OR 'pregnant' OR 'conception' OR 'childbearing' OR 'birth' OR 'births' OR 'pregnancies' OR 'delivery' OR 'deliveries') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another') NOT 'outcomes' OR ('teenage pregnancy'/exp OR 'teenage pregnancy' OR 'teenage birth' OR 'teenage pregnancies' OR 'teenage	8675

No.	Query	Results
	births' OR 'adolescent birth' OR 'adolescent births' OR 'adolescent pregnancies' OR 'adolescent pregnancy'/exp OR 'adolescent pregnancy' AND ('factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR 'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another') NOT 'outcomes') AND ([adolescent]/lim OR [adult]/lim OR [young adult]/lim) AND (1980:py OR 1981:py OR 1982:py OR 1983:py OR 1984:py OR 1985:py OR 1986:py OR 1987:py OR 1988:py OR 1989:py OR 1990:py OR 1991:py OR 1992:py OR 1993:py OR 1994:py OR 1995:py OR 1996:py OR 1997:py OR 1998:py OR 1999:py OR 2000:py OR 2001:py OR 2002:py OR 2003:py OR 2004:py OR 2005:py OR 2006:py OR 2007:py OR 2008:py OR 2009:py OR 2010:py OR 2011:py OR 2012:py OR 2013:py OR 2014:py OR 2015:py) AND [female]/lim	
#17	'factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR 'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason' AND ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' OR ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' AND ('mother' OR 'mothers' OR 'moms' OR 'mom' OR 'parent' OR 'parents'))) AND ('pregnancy' OR 'pregnant' OR 'conception' OR 'childbearing' OR 'birth' OR 'births' OR 'pregnancies' OR 'delivery' OR 'deliveries') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another') NOT 'outcomes' OR ('teenage pregnancy'/exp OR 'teenage pregnancy' OR 'teenage birth' OR 'teenage pregnancies' OR 'teenage births' OR 'adolescent birth' OR 'adolescent births' OR 'adolescent pregnancies' OR 'adolescent pregnancy'/exp OR 'adolescent pregnancy' AND ('factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR 'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another') NOT 'outcomes') AND ([adolescent]/lim OR [adult]/lim OR [young adult]/lim) AND (1980:py OR 1981:py OR 1982:py OR 1983:py OR 1984:py OR 1985:py OR 1986:py OR 1987:py OR 1988:py OR 1989:py OR 1990:py OR 1991:py OR 1992:py OR 1993:py OR 1994:py OR 1995:py OR 1996:py OR 1997:py OR 1998:py OR 1999:py OR 2000:py OR 2001:py OR 2002:py OR 2003:py OR 2004:py OR 2005:py OR 2006:py OR 2007:py OR 2008:py OR 2009:py OR 2010:py OR 2011:py OR 2012:py OR 2013:py OR 2014:py OR 2015:py)	10025
#16	'factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR 'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason' AND ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' OR ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' AND ('mother' OR 'mothers' OR 'moms' OR 'mom' OR 'parent' OR 'parents'))) AND ('pregnancy' OR 'pregnant' OR 'conception' OR 'childbearing' OR 'birth' OR 'births' OR 'pregnancies' OR 'delivery' OR 'deliveries') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another') NOT 'outcomes' OR ('teenage pregnancy'/exp OR 'teenage pregnancy' OR 'teenage birth' OR 'teenage pregnancies' OR 'teenage	14445

No.	Query	Results
	births' OR 'adolescent birth' OR 'adolescent births' OR 'adolescent pregnancies' OR 'adolescent pregnancy'/exp OR 'adolescent pregnancy' AND ('factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR 'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another') NOT 'outcomes')	
#15	'teenage pregnancy'/exp OR 'teenage pregnancy' OR 'teenage birth' OR 'teenage pregnancies' OR 'teenage births' OR 'adolescent birth' OR 'adolescent births' OR 'adolescent pregnancies' OR 'adolescent pregnancy'/exp OR 'adolescent pregnancy' AND ('factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR 'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another') NOT 'outcomes'	783
#14	'factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR 'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason' AND ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' OR ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' AND ('mother' OR 'mothers' OR 'moms' OR 'mom' OR 'parent' OR 'parents'))) AND ('pregnancy' OR 'pregnant' OR 'conception' OR 'childbearing' OR 'birth' OR 'births' OR 'pregnancies' OR 'delivery' OR 'deliveries') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another') NOT 'outcomes'	14445
#13	'teenage pregnancy'/exp OR 'teenage pregnancy' OR 'teenage birth' OR 'teenage pregnancies' OR 'teenage births' OR 'adolescent birth' OR 'adolescent births' OR 'adolescent pregnancies' OR 'adolescent pregnancy'/exp OR 'adolescent pregnancy' AND ('factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR 'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another')	986
#12	'factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR 'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason' AND ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' OR ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' AND ('mother' OR 'mothers' OR 'moms' OR 'mom' OR 'parent' OR 'parents'))) AND ('pregnancy' OR 'pregnant' OR 'conception' OR 'childbearing' OR 'birth' OR 'births' OR 'pregnancies' OR 'delivery' OR 'deliveries') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another')	16894
#11	'teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' OR ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' AND ('mother' OR 'mothers' OR 'moms' OR 'mom' OR 'parent' OR 'parents')) AND ('pregnancy' OR 'pregnant' OR 'conception' OR 'childbearing' OR 'birth' OR 'births' OR 'pregnancies' OR 'delivery' OR 'deliveries') AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR	30516

No.	Query	Results
	'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another')	
#10	'pregnancy' OR 'pregnant' OR 'conception' OR 'childbearing' OR 'birth' OR 'births' OR 'pregnancies' OR 'delivery' OR 'deliveries' AND ('repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another')	301639
#9	'repeat' OR 'repeated' OR 'repeats' OR 'subsequent' OR 'multiple' OR 'secondary' OR 'second' OR 'next' OR 'recurrent' OR 'recurrence' OR 'another'	4552920
#8	'pregnancy' OR 'pregnant' OR 'conception' OR 'childbearing' OR 'birth' OR 'births' OR 'pregnancies' OR 'delivery' OR 'deliveries'	1530671
#7	'teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' OR ('teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' AND ('mother' OR 'mothers' OR 'moms' OR 'mom' OR 'parent' OR 'parents'))	2001032
#6	'teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth' AND ('mother' OR 'mothers' OR 'moms' OR 'mom' OR 'parent' OR 'parents')	115799
#5	'mother' OR 'mothers' OR 'moms' OR 'mom' OR 'parent' OR 'parents'	485821
#4	'teen' OR 'teenage' OR 'teenager' OR 'teens' OR 'teenagers' OR 'adolescent' OR 'adolescents' OR 'young' OR 'young adults' OR 'young adult' OR 'youth'	2001032
#3	'factors' OR 'factor' OR 'predictor' OR 'predictors' OR 'risks' OR 'risk' OR 'determinants' OR 'determinant' OR 'cause' OR 'causes' OR 'reasons' OR 'reason'	6615006
#2	child OR children OR kids OR kid OR deliver* OR birth* OR infant* OR baby OR babies OR offspring* OR pregnant OR pregnancy OR gravid* OR conception* OR childbearing OR pregnancies AND (repeat* OR subsequen* OR secondary OR second OR multiple OR many OR several OR another OR recurrence OR recurrent OR again OR succeed* OR later OR next) AND (mother* OR mom OR parent* OR moms AND (teen* OR adolescen* OR young OR youth OR 'under 20' OR 'under twenty' OR 'young adult' OR minor*) OR teen* OR adolescen* OR young OR youth OR 'under 20' OR 'under twenty' OR 'young adult' OR minor*) AND (factor* OR predictor* OR risk OR cause* OR reason* OR dynamic* OR influence* OR origin* OR basis OR bases OR risks)	167618
#1	'teenage pregnancy'/exp OR 'teenage pregnancy' OR 'teenage birth' OR 'teenage pregnancies' OR 'teenage births' OR 'adolescent birth' OR 'adolescent births' OR 'adolescent pregnancies' OR 'adolescent pregnancy'/exp OR 'adolescent pregnancy'	8700

Table S. 8. Assessed predictors and outcomes

Authors (Year)	Predictors assessed* (Measurement)	Outcomes (Definition)
Barnet, et al. (2008)	Maternal age (Q) Medicaid insurance (Q) Received assistance last month (Q) Lives with mother (Q) Not in school/dropped out (Q) Previous pregnancy (Q) Previous birth (Q) Previous abortion (Q) Previous miscarriage/still birth (Q) Wants another pregnancy within 2y of index child (Q) Trying to become again (Q) Condom use (Q) Parent beat /physically harmed (Q) Sexually abused (Q) Conflict tactics scale score (Q) Tobacco use (Q) Alcohol use (Q) Drugs use (Q) Age at baseline (Q) Age difference between teen mother and baby's father (Q) Married, living together or going with baby's father at baseline (Q) Depression (CES-D)	RRP (Occurrence of repeated pregnancy by 2y postpartum)
Bennett, et al. (2013)	Literacy level (SAT)	RB (Second birth before 20 years old)
Black, et al. (2006)	Friends have baby (Q) Fighting (Q) Cigarette use (Q) Alcohol use (Q) Marijuana use (Q) Experienced stealing (Q) Arrested (Q) Jailed (Q) More than 1 sexual partner (Q) Having STI (Q) Maternal age at delivery (Q) Dropped out from school (Q) Breastfeeding (Q) Romantic relationship with the father of baby (Q) Plan to have a second baby in next 5 year (Q) Advanced in education since delivery (Q) Married (Q) Live with partner (Q) Live with grandmother (Q) Romantic relationship with new partner (Q) Self-esteem (RS) Depressed (BDI) Parenting Satisfaction (PSC) Parenting Efficacy (PSC) Negative life events (LES) Positive life events (LES) Support from infant's grandmother (NRI) Conflict with infant's grandmother (NRI) Reading and math (KF)	RRB (Second birth 24m after the delivery of the first child)
Boardman, et al. (2006)	Age at first conception (Q) Race (Q) Education of teen's mother (Q) Age of teen's mom (Q) Did not live in 2-parent household as teen (Q) Religion in which raised (Q) Married at second conception (Q) Age at menarche (Q) First pregnancy intended by teen (Q) Prior poor obstetric outcome (Q) Age of partner during second conception (Q) Second pregnancy intended by partner (Q)	Intended or unintended RRP(Intended or unintended second pregnancy experienced by adolescent within 24m of the resolution of the first pregnancy which could have ended in miscarriage, elective abortion, ectopic pregnancy, preterm or term stillbirth, or preterm or term live birth)
Coard, et al. (2000)	Age (Q) School status (Q) In school or drop out Number in household (Q) Maternal education (Q) Reaction of adolescent's mother to pregnancy (Q) Reaction of baby's father to pregnancy (Q) Primary caretaker for baby (Q) Current contraceptive use (Q) Current contraceptive method (Q) Number of lifetime abortions (Q) Number of lifetime miscarriages (Q)	RRP (Repeated pregnancy within 1y or between 1y-2y postpartum)
Crittenden, et al. (2009)	Mental health index (RAND) Anxiety (Q) Depression (Q) Aggression proxy (Q) Substance use (Q) Birth control use (Q)	RRP (Occurrence of pregnancy within 24m of the previous pregnancy)

Authors (Year)	Predictors assessed* (Measurement)	Outcomes (Definition)
	Negative life experience (Q) Age (Q) Household size (Q) Households income (Q) Highest level of education (Q) Age at first period (Q) Age at first intercourse (Q) Maternal social support (Q) Maternal number of children (Q) African-American ethnicity (Q) Lived in subsidized housing (Q) Being head of household (Q) Employed (Q) Parents living apart before age 13 (Q) Maternal education (Q)	
Crosby, et al. (2002)	Parental monitoring (Q)	RRP (Occurrence of another pregnancy after 6m postpartum of the first pregnancy)
Damle, et al. (2015)	Number of prenatal care visits (Q) Contraception not initiated prior to discharge postpartum (Q) Attended postpartum visit within 8 weeks (Q) Long acting reversible contraceptive (LARC) initiation by 8 weeks postpartum (Q) Initiation to start LARC started at 8-weeks postpartum (Q)	RRP (Another pregnancy within 2y after the first child)
Davis (2002)	Self-esteem (RS) Locus of control (RM) Educational aspirations (Q) Religiosity (Q) Co-residence with kin(Q) Expelled or suspended in school (Q) Involved in theft (Q) Engagement in violent behavior (Q) Use of illegal drugs (Q) Race (Q) Religion (Q) Income (Q) Age at birth of first birth (Q)	RP (Occurrence of another pregnancy among unwed adolescent mothers)
De Fatima, et al. (2012)	Age per year (PNA) Age at first pregnancy (PNA) Age at first sexual intercourse (PNA) Time until first pregnancy (PNA) Use of contraceptives (PNA) Prenatal examinations (PNA) Age dropped out from school (PNA) Currently attending school (PNA) Year not attending school (PNA) Years of education (PNA) Monthly income (PNA) Living with partner (PNA) Currently working (PNA)	RP (Having two or more pregnancies)
Gillmore, et al. (1997)	Contraceptive use (Q) Frequency of intercourse (Q) Breastfeeding (Q) School expulsion/suspension (Q) Drug use (Q and UT) Fighting/delinquency (Q) Peer relationships/associations (Q) Living with parents (Q) Length of relationship with boyfriends (Q) Best friends experiencing pregnancies (Q) Age at first birth of first child Race and socio-economic status (Q)	RRP (Another pregnancy that occurs within 18m after the first birth)
Gray, et al. (2006)	Age at conception (Q) Race (Q) Educational status (Q) Marital status (Q) Prenatal contraceptive plan (Q) Formulated educational/career goals (Q) Use of contraception (Q)	RRP (Become pregnant again either between 0m-6m, 7m-12m, 13m-24m)
Jacoby, et al. (1999)	Spontaneous abortion (RR) Any form of physical or sexual violence during study period (RR) Family stress (RR) Financial stress (RR) Environmental stressors (RR) Demographics (RR)	RRP (Pregnancy 12m or 24m after the previous pregnancy)
Lewis, et al. (2010)	Type of contraceptive (LMUP) Ongoing sexual intercourse over 3 months (LMUP) Intends to become pregnant (LMUP) Indigenous Australian (ABS)	RRP (Teen mothers who experiences a pregnancy within 2y of a first teen birth)
Manlove, et al. (2000)	Race/ethnicity (Q) Family structure (Q) Individual characteristics after pregnancy or first birth (Q) Religious involvement (Q) School and classroom characteristics (Q) School performance (Q)	RB and RRB (Second birth at the 24th month assessment or at any time since the birth of the first child among teenagers)

Authors (Year)	Predictors assessed* (Measurement)	Outcomes (Definition)
	Enrolled in further education (Q) Educational achievement after first birth (Q) Age at first birth (Q) Dropout history (Q) Marital history (Q) Child care received after first birth (Q) Living situation after first birth (Q)	
Milbrook (2013)	Placement change (Q) Case manager changes (Q) School changes (Q) Age at birth of first child (Q) Enrolment status (Q)	RP (Number of pregnancy before age of 21 from enrolment)
Montgomery (2010)	Age (Q) Frequency and recency of sexual intercourse (Q) Suspension or expulsion (Q) Cigarette use (Q) Alcohol use (Q) Marijuana use (Q) Trying to get pregnant (Q) Number of sexual partners (Q) Positive marriage expectations (Q) Hopeless regarding future (Q) Expectations for adulthood (Q) Family rules (Q) Curfew (Q) parental monitoring (Q) Involved in organized activities (Q) Work at paid job (Q) Enrolled in school during previous year (Q) Want to finish high school (Q) Think will finish high school (Q) Want to go to college (Q) Think will go to college (Q) Warmth toward mother (Q) Absence of father figure (Q) Able to discuss sex with parents (Q) Have discussed sex with parents (Q) Parents' feeling if got pregnant (Q) Boy having sex proves he is a man (Q) Girl having sex proves she is a woman (Q) Negative peer pressure (Q) Feelings if got pregnant (Q) Self-worth (Q)	RRP (Reporting of one pregnancy with an additional pregnancy within 2y after the first)
Patel, et al. (1997)	Race/ ethnicity (RR) Parity (RR) Maternal Age (RR)	RB (Teenagers with at least 1 live birth from multiple gestation)
Pfitzner, et al. (2003)	Maternal age at entry (RR) Maternal age at delivery (RR) Maternal age at exit (RR) Paternal age at entry (RR) Paternal maternal age difference (RR) Time known father of baby (RR) Time in program (RR) Gestational age when prenatal care began (RR) Infant's birth weight (RR) Last grade completed (RR) Months out of school (RR) Physical abuse (Q) Sexual abuse (Q) Depression (Q) Suicidality (Q) Significant Psychiatric history (Q) Alcohol use (Q) Tobacco use (Q) Illicit drug use (Q) Parent a pregnant teen (Q) Planned pregnancy (Q) Placed child for adoption (Q) School attendance at entry (Q) Maternal ethnicity (Q) Relationship at conception (Q) Paternal ethnicity (Q) Pregnancy outcome (Q) Educational status at exit (Q) Relationship which father of baby at exit (Q) Exit reason (Q) Payer source (Q)	RP (Teenagers who experienced a repeat pregnancy)
Raneri and Wiemann (2007)	Self-esteem (RS) Depressive symptoms (BDI) Substance abuse (Q) Sexual activity (Q) Contraceptive use (Q) Living arrangement (Q) Romantic relationship (Q) Partner abuse (Q)	RRP (Subsequent pregnancy or birth on one or more surveys within 24m)

Authors (Year)	Predictors assessed* (Measurement)	Outcomes (Definition)
	Intention to have pregnancy (Q) Age of father of first child (Q) Maternal closeness (Q) Maternal monitoring (Q) Social support from family (Q) Overall support from any course (Q) Chronic verbal abuse (Q) Hit by a family member (Q) Enrolled in school (Q) Dropped out of school prior to first pregnancy (Q) Repeated at least one grade (Q) Enrolled in school (Q) Employed full- or part-time (Q) Higher religiosity (Q) At least half of friends were teenage mothers (Q) At least half of friends dropped out of high school (Q) Social stigma regarding teenage parenting (Q) Community violence (Q) Race (Q) Economic resources (Q)	
Richio, et al. (2010)	History of mode of delivery (Q)	RRB (Repeat births within 2y after first birth)
Sangalang, et al. (2006)	Age (Q) Race (Q) Marital status (Q)	RB (Occurrence of second birth)
Sims and Luster (2002)	Age (Q) Repeated grade (Q) Educational expectations (Q) Living with male partner (Q) Mother's education (Q) Sexual abuse (Q) Perception of family support (Q) Self-esteem (RS) Locus of control (RM) Depression (CES-D) Personal resources (Q)	RRP (Occurrence of pregnancy at the 24th m of assessment at any time since the birth of the first child) RRB (Occurrence of birth at the 24th m of assessment at any time since the birth of the first child)
Steven-Simon, et al. (1998)	School drop-out (Q) Inconsistent contraceptive use "harder to modify" explanation (Q)	RRP (Occurrence of another within 18m of study)
Stevens-Simon, et al. (2001)	Number of risk factors present (Q) Use of Norplant (Q) Use of Depo-Provera during the puerperium (Q)	RRP (Another pregnancy 24m from the first delivery)
Tocce, et al. (2012)	Did not receive immediate postpartum implant (Q)	RRP (Repeat pregnancy 12m after delivery

Measurement: ABS-Australian bureau of statistics index of relative social disadvantage, BDI-Beck depression inventory, CES-D-Center of epidemiologic studies depression scale, KF-Kaufman functional academic skills test, LES-Life experience survey, LMUP-London measure of unplanned pregnancy, NRI-Network of relationship inventory, PNA-Perinatal needs assessment, PSC- Parenting sense of competence scale, Q-Questionnaire, RAND-RAND mental health inventory, RM-Rotter's measure, RR-Records review, RS-Rosenberg's scale, SAT-Stanford achievement test, UT-Urine test; *-Not necessarily in the final model

Table S. 9. Meta-analyses of factors associated with repeated teenage pregnancies and births using random-effects model: Pooled odd ratios and level of heterogeneity (n=47 factors)

		Pooled ES				Heterogeneity			Egger's bias		Begg's score		
Predictors	**n**	**OR**	**LCI**	**HCI**	**p**	**Q**	**p**	**I^2**	**S**	**p**	**S**	**p**	**p***
A/PNC visitations	2	0.371	0.053	2.58	0.316	17.41	<0.001	94.30%	-4.58	NA	-1	0.317	1
Adolescent's mother was a teen mother	2	1.056	0.784	1.421	0.72	0.09	0.766	0.00%	0.94	NA	1	0.317	1
Age at first sexual intercourse	2	0.997	0.584	1.701	0.991	7.61	0.006	86.90%	4.33	NA	1	0.317	1
Age at menarche	2	1.095	0.82	1.462	0.537	2.94	0.087	66.00%	-3.24	NA	-1	0.317	1
Age during first conception	10	0.989	0.868	1.128	0.874	77.72	<0.001	88.40%	-0.42	0.736	5	0.655	0.721
Age of the father at baseline	2	1.108	0.681	1.802	0.68	4.77	0.029	79.00%	3.23	NA	1	0.317	1
Age of the teenager	10	1.138	0.885	1.463	0.313	64.66	<0.001	86.10%	-1.97	0.198	-13	0.245	0.283
Alcohol use	5	1.332	0.89	1.991	0.163	1.62	0.805	0.00%	1.06	0.294	4	0.327	0.462
Depression	5	1.457	1.136	1.868	0.003	4.36	0.36	8.20%	0.65	0.645	2	0.624	0.806
Drug use	7	1.019	0.815	1.274	0.868	5.82	0.443	0.00%	-0.23	0.805	-9	0.176	0.23
Education of adolescent's mother	4	0.889	0.618	1.279	0.528	8.87	0.031	66.20%	-3.87	0.034	-6	0.042	0.089
Educational/career goals	4	0.953	0.905	1.003	0.065	5.12	0.163	41.40%	-1.44	0.111	-2	0.497	0.734
Employment	5	0.814	0.548	1.209	0.308	15.46	0.004	74.10%	-1.27	0.326	-2	0.624	0.806
Experienced physical or sexual abuse	5	1.405	0.953	2.07	0.086	9.97	0.041	59.90%	1.79	0.299	6	0.142	0.221
Frequency and recency of sexual intercourse	3	1.241	0.915	1.683	0.165	11.81	0.003	83.10%	2.57	0.066	3	0.117	0.296
Having a contraceptive plan	2	0.484	0.032	7.295	0.6	3.45	0.063	71.00%	-2.93	NA	-1	0.317	1
Highest level of education	7	0.741	0.603	0.911	0.004	18.02	0.006	66.70%	-0.83	0.461	-5	0.453	0.548
History of abortion/miscarriage	6	1.659	1.082	2.544	0.02	18.81	0.002	73.40%	2.78	0.184	5	0.348	0.452
Household size	2	0.979	0.954	1.005	0.105	0.19	0.667	0.00%	0.46	NA	1	0.317	1
In a relationship with the father of their first child	3	1.05	0.478	2.305	0.904	16.44	<0.001	87.80%	3.22	0.657	1	0.602	1
Income	5	0.93	0.788	1.098	0.393	8.62	0.035	65.20%	-0.16	0.934	0	1	1
Intending to become pregnant again	5	1.216	0.661	2.239	0.529	21.49	<0.001	81.40%	0.95	0.733	0	1	1
Living with at least 1 parent/kin	7	1.072	0.618	1.86	0.804	35.19	<0.001	82.90%	2.43	0.36	1	0.881	1
Living with partner	4	1.849	1.38	2.477	<0.001	4	0.262	25.00%	2.1	0.31	2	0.497	0.734
Locus of control	3	1.354	0.869	2.109	0.18	7.94	0.019	74.80%	2.18	0.01	3	0.117	0.296
Married	6	1.029	0.793	1.334	0.83	18.81	0.002	73.40%	-0.49	0.725	1	0.851	1
Number of sexual partners	2	1.269	0.787	2.046	0.328	0.07	0.784	0.00%	0.36	NA	1	0.317	1
Parental monitoring	2	1.403	0.547	3.602	0.481	4.93	0.026	79.70%	3	NA	1	0.317	1
Parity	2	1.659	1.425	1.931	<0.001	0.48	0.486	0.00%	0.93	NA	1	0.317	1
Partner support	3	1.429	1.133	1.802	0.003	0.97	0.615	0.00%	1.21	0.273	1	0.602	1
Partner-adolescent age difference	4	1.205	1.034	1.405	0.017	3.65	0.301	17.90%	1.49	0.191	2	0.497	0.734
Peers are teen mothers	3	1.643	1.178	2.291	0.003	1.51	0.471	0.00%	0.06	0.978	1	0.602	1
Planned first pregnancy	2	1.735	1.3	2.316	<0.001	0.38	0.538	0.00%	-6.56	NA	-1	0.317	1
Presence of multiple risk factors	3	2.604	1.836	3.694	<0.001	0.64	0.727	0.00%	4.05	0.242	3	0.117	0.296
Race	10	1.135	0.924	1.394	0.228	63.51	<0.001	85.80%	1.08	0.41	3	0.788	0.858
Received insurance or subsidy	5	1.106	0.872	1.403	0.405	5.88	0.209	31.90%	-1.72	0.528	-6	0.142	0.221
Religion	2	0.725	0.448	1.172	0.19	5.32	0.021	81.20%	-3.63	NA	-1	0.317	1
Religious involvement	3	1.193	1.062	1.339	0.003	1.84	0.399	0.00%	1.8	0.257	3	0.117	0.296
School drop-out	8	1.894	1.19	3.014	0.007	31.98	<0.001	78.10%	1.21	0.501	10	0.216	0.266
School expulsion/suspension	3	1.406	0.867	2.279	0.167	10.41	0.005	80.80%	2.27	0.242	3	0.117	0.296
School performance	4	1.02	1.003	1.037	0.02	1.58	0.664	0.00%	0.58	0.441	1*	0.734	1
Self-esteem	4	1.025	0.784	1.341	0.856	11.08	0.011	72.90%	0.39	0.8	2	0.497	0.734
Smoking	5	1.219	0.85	1.748	0.282	3.4	0.493	0.00%	-0.61	0.726	-4	0.327	0.462
Support from adolescent's mother	5	1.081	0.988	1.183	0.089	4.33	0.364	7.50%	0.77	0.303	6	0.142	0.221
Use of contraception	8	0.596	0.348	1.02	0.059	62.49	<0.001	88.80%	-2.65	0.498	-6	0.458	0.536
Use of LARC immediate postpartum	4	0.193	0.082	0.452	<0.001	8.79	0.032	65.90%	-2.64	0.045	0	1	1
Violence	3	1.357	1.029	1.79	0.03	0.69	0.709	0.00%	0.39	0.747	1	0.602	1

Legend: n-number of studies, OR=odds ratio, LCI- lower 95% confidence interval, HCI- lower 95% confidence interval, p*-corrected p-value, NA-not applicable

Table S. 10. Comparison of random effects and quality effects meta-analyses 47 factors associated with repeated teenage pregnancies and births: Pooled odd ratios and level of heterogeneity

		Random-Effects Model					Quality-Effects Model				
Predictors	**n**	**OR**	**LCI**	**HCI**	**Q**	**I^2**	**OR**	**LCI**	**HCI**	**Q**	**I^2**
A/PNC visitations	2	0.371	0.053	2.58	17.41	94.30%	0.933	0.066	13.242	17.41	94.26%
Adolescent's mother was a teen mother	2	1.056	0.784	1.421	0.09	0.00%	1.049	0.777	1.416	0.09	0.00%
Age at first sexual intercourse	2	0.997	0.584	1.701	7.61	86.90%	0.898	0.507	1.592	7.61	86.87%
Age at menarche	2	1.095	0.82	1.462	2.94	66.00%	1.135	0.843	1.529	2.94	65.97%
Age during first conception	10	0.989	0.868	1.128	77.72	88.40%	1.056	0.878	1.269	77.71	88.42%
Age of the father at baseline	2	1.108	0.681	1.802	4.77	79.00%	1.028	0.619	1.708	4.77	79.05%
Age of the teenager	10	1.138	0.885	1.463	64.66	86.10%	1.232	0.938	1.618	64.66	86.08%
Alcohol use	5	1.332	0.89	1.991	1.62	0.00%	1.385	0.912	2.105	1.62	0.00%
Depression	5	1.457	1.136	1.868	4.36	8.20%	1.468	1.136	1.898	4.36	8.17%
Drug use	7	1.019	0.815	1.274	5.82	0.00%	1.018	0.793	1.305	5.82	0.00%
Education of adolescent's mother	4	0.889	0.618	1.279	8.87	66.20%	0.954	0.658	1.384	8.87	66.17%
Educational/career goals	4	0.953	0.905	1.003	5.12	41.40%	0.971	0.916	1.030	5.12	41.41%
Employment	5	0.814	0.548	1.209	15.46	74.10%	1.017	0.520	1.988	15.46	74.12%
Experienced physical or sexual abuse	5	1.405	0.953	2.07	9.97	59.90%	1.324	0.883	1.986	9.97	59.87%
Frequency and recency of sexual intercourse	3	1.241	0.915	1.683	11.81	83.10%	1.390	0.953	2.029	11.81	83.06%
Having a contraceptive plan	2	0.484	0.032	7.295	3.45	71.00%	1.089	0.047	25.253	3.45	71.04%
Highest level of education	7	0.741	0.603	0.911	18.02	66.70%	0.752	0.596	0.947	18.02	66.70%
History of abortion/miscarriage	**6**	**1.659**	**1.082**	**2.544**	**18.81**	**73.40%**	**1.437**	**0.895**	**2.306**	**18.81**	**73.41%**
Household size	2	0.979	0.954	1.005	0.19	0.00%	0.983	0.951	1.017	0.19	0.00%
In a relationship with the father of their first child	3	1.05	0.478	2.305	16.44	87.80%	0.872	0.386	1.969	16.44	87.84%
Income	5	0.93	0.788	1.098	8.62	65.20%	0.946	0.756	1.184	8.62	65.19%
Intending to become pregnant again	5	1.216	0.661	2.239	21.49	81.40%	1.069	0.534	2.138	21.49	81.38%
Living with at least 1 parent/kin	7	1.072	0.618	1.86	35.19	82.90%	0.886	0.443	1.774	35.19	82.95%
Living with partner	4	1.849	1.38	2.477	4	25.00%	1.866	1.376	2.529	4.00	24.97%
Locus of control	3	1.354	0.869	2.109	7.94	74.80%	1.112	0.643	1.925	7.94	74.80%
Married	6	1.029	0.793	1.334	18.81	73.40%	1.121	0.840	1.496	18.81	73.42%
Number of sexual partners	2	1.269	0.787	2.046	0.07	0.00%	1.285	0.790	2.090	0.07	0.00%
Parental monitoring	2	1.403	0.547	3.602	4.93	79.70%	0.985	0.306	3.174	4.93	79.72%
Parity	2	1.659	1.425	1.931	0.48	0.00%	1.765	1.400	2.225	0.48	0.00%
Partner support	3	1.429	1.133	1.802	0.97	0.00%	1.426	1.131	1.799	0.97	0.00%
Partner-adolescent age difference	4	1.205	1.034	1.405	3.65	17.90%	1.227	1.049	1.435	3.65	17.91%
Peers are teen mothers	3	1.643	1.178	2.291	1.51	0.00%	1.604	1.147	2.242	1.51	0.00%
Planned first pregnancy	2	1.735	1.3	2.316	0.38	0.00%	1.768	1.317	2.375	0.38	0.00%
Presence of multiple risk factors	3	2.604	1.836	3.694	0.64	0.00%	2.618	1.845	3.716	0.64	0.00%
Race	10	1.135	0.924	1.394	63.51	85.80%	1.016	0.717	1.441	63.51	85.83%
Received insurance or subsidy	5	1.106	0.872	1.403	5.88	31.90%	1.124	0.882	1.432	5.88	31.93%
Religion	2	0.725	0.448	1.172	5.32	81.20%	0.766	0.468	1.254	5.32	81.22%
Religious involvement	3	1.193	1.062	1.339	1.84	0.00%	1.195	1.062	1.344	1.84	0.00%
School drop-out	8	1.894	1.19	3.014	31.98	78.10%	1.772	1.051	2.987	31.98	78.11%
School expulsion/suspension	3	1.406	0.867	2.279	10.41	80.80%	1.268	0.712	2.257	10.41	80.79%
School performance	4	1.02	1.003	1.037	1.58	0.00%	1.025	1.006	1.045	1.58	0.00%
Self-esteem	4	1.025	0.784	1.341	11.08	72.90%	1.071	0.779	1.472	11.08	72.92%
Smoking	5	1.219	0.85	1.748	3.4	0.00%	1.221	0.841	1.772	3.40	0.00%
Support from adolescent's mother	5	1.081	0.988	1.183	4.33	7.50%	1.084	0.989	1.188	4.33	7.54%
Use of contraception	8	0.596	0.348	1.02	62.49	88.80%	0.610	0.344	1.084	62.49	88.80%
Use of LARC immediate postpartum	4	0.193	0.082	0.452	8.79	65.90%	0.321	0.105	0.981	8.79	65.86%
Violence	3	1.357	1.029	1.79	0.69	0.00%	1.367	0.997	1.875	0.69	0.00%

Legend: n-number of studies, OR=odds ratio, LCI- lower 95% confidence interval, HCI- lower 95% confidence interval

Table S. 11. Sensitivity analyses of age during pregnancy and use of contraception

Excluded study	Pooled Effect Size			Heterogeneity				
	OR	LCI	HCI	Q	p	I^2	LCI	HCI
Age during first conception								
Milbrook, 2013	0.97	0.85	1.11	73.681	<0.001	89.14%	81.62	93.59
Black, et al., 2006	0.96	0.84	1.09	73.156	<0.001	89.06%	81.47	93.55
Davis, 2002	1.04	0.91	1.18	65.184	<0.001	87.73%	78.84	92.88
Gray, et al., 2006	1.00	0.88	1.14	74.628	<0.001	89.28%	81.89	93.66
Gillmore, et al., 1997	0.96	0.84	1.10	71.466	<0.001	88.81%	80.96	93.42
de Fatima, et al., 2012	1.04	0.91	1.19	59.206	<0.001	86.49%	76.35	92.28
Boardman, et al., 2006	0.93	0.81	1.06	67.040	<0.001	88.07%	79.51	93.05
Manlove, et al., 2000	1.01	0.77	1.31	77.139	<0.001	89.63%	82.56	93.83
Manlove, et al., 2000.	1.00	0.78	1.29	77.019	<0.001	89.61%	82.53	93.82
Pfitzner, et al., 2003	1.05	0.93	1.19	59.508	<0.001	86.56%	76.49	92.31
Use of contraception								
Gray, et al., 2006	0.63	0.36	1.13	60.006	<0.001	90.00%	81.95	94.46
Gillmore, et al., 1997	0.63	0.34	1.16	53.279	<0.001	88.74%	79.26	93.89
de Fatima, et al., 2012	**0.50**	**0.37**	**0.66**	**12.183**	**0.058**	**50.75%**	**0.00**	**79.10**
Barnet, et al., 2008	0.60	0.32	1.14	60.843	<0.001	90.14%	82.24	94.53
Crittenden, et al., 2009	0.55	0.30	1.03	59.640	<0.001	89.94%	81.82	94.43
Damle, et al., 2015	0.63	0.35	1.13	59.665	<0.001	89.94%	81.83	94.44
Coard, et al., 2000	0.65	0.37	1.15	58.872	<0.001	89.81%	81.54	94.37
Lewis, et al.,2010	0.61	0.33	1.12	61.177	<0.001	90.19%	82.35	94.55

Legend: OR=odds ratio, LCI=lower 95% confidence interval, HCI=lower 95% confidence interval; p=p-value

Appendix 5: Online supplementary material of paper 6.2

This material supplements but does not replace the content of the peer-reviewed paper published in Maternal and Child Health Journal.

Table S. 12. Correlates of repeated pregnancy among adolescents and young adults: Final model adjusted for current age expressed in Odds ratio (95% Confidence Interval)

Correlates	Univariate	Final + Current age
Socio-economic position		
Education		
Completed HS	1	1
No education/Did not finish HS	**1·81 (1·59-2·05)**	1·27 (0·94-1·71)
Income class		
Upper	1	1
Middle	**1·67 (1·39-2·00)**	**1·59 (1·06-2·39)**
Lower	**2·29 (1·96-2·67)**	**1·71 (1·17-2·52)**
First pregnancy		
Age of first birth (in years)*	**0·95 (0·94-0·95)**	**0·90 (0·88-0·92)**
Intention		
Unplanned	1	1
Planned	**1·56 (1·34-1·81)**	1·02 (0·76-1·36)
Prenatal care provider		
Unplanned	1	1
Traditional healer	**1·57 (1·26-1·96)**	0·93 (0·64-1·34)
Partner characteristics		
Partner's age		
15-24	1	1
25-29	**1·72 (1·45-2·05)**	1·20 (0·89-1·62)
≥30	**2·37 (1·91-2·94)**	**1·46 (1·00-2·14)**
Residing with husband		
Yes	**1·53 (1·19-1·95)**	**1·70 (1·09-2·64)**
Number of intimate relationships		
>1	**3·38 (2·02-5·66)**	**4·19 (1·57-11·19)**
Educational Attainment		
Completed HS	1	1
No education/Didn't finish HS	**1·65 (1·44-1·90)**	**1·38 (1·02-1·87)**

Notes: All steps were adjusted for current use of contraception, survey year, type of residence and religion. Current age is in years and is centered at 18. *Centred at 18 years.

Table S. 13. Correlates of repeated pregnancy by age groups (15-18, 19-21 and 22-24 years old) using fully adjusted model expressed in Odds ratio (95% Confidence Interval)

Correlates	Age groups (in years)		
	15-18	**19-21**	**22-24**
n	*287*	*948*	*1129*
Socio-economic position			
Educational Attainment			
Completed HS	1	1	1
No education/Didn't finish HS	3·91 (0·54-28·43)	1·22 (0·78-1·91)	1·08 (0·70-1·66)
Income class			
Upper	1	1	1
Middle	3·25 (0·62-17·11)	1·55 (0·80-3·04)	1·31 (0·76-2·23)
Lower	1·34 (0·29-2·79)	1·73 (0·92-3·23)	**1·93 (1·15-3·23)**
First pregnancy			
Age of first birth (in years)*	**1·16 (1·05-1·28)**	**0·79 (0·71-0·88)**	**0·91 (0·89-0·94)**
Intention			
Unplanned	1	1	1
Planned	**4·50 (1·17-17·30)**	1·08 (0·70-1·67)	0·82 (0·53-1·27)
Prenatal care provider			
Health professional	1	1	1
Traditional healer	1·86 (0·57-6·14)	0·82 (0·47-1·45)	0·70 (0·41-1·19)
Partner characteristics			
Partner's age (in years)			
15-19	1	0·54 (0·20-1·49)	1·77 (0·22-13·92)
20-24	0·99 (0·22-4·42)	1	1
25-29	0·41 (0·07-2·34)	1·28 (0·81-2·03)	1·35 (0·87-2·10)
≥30	2·24 (0·19-26·80)	1·42 (0·77-2·61)	1·55 (0·90-2·67)
Residing with husband			
Yes	0·62 (0·13-2·79)	**2·05 (1·08-3·88)**	1·68 (0·89-3·18)
Number of intimate relationships			
>1	2·28 (0·33-15·81)	1·25 (0·22-7·19)	**16·76 (2·62-107·16)**
Educational Attainment			
Completed HS	1	1	1
No education/Didn't finish HS	1·02 (0·35-2·97)	**1·61 (1·02-2·55)**	1·09 (0·69-1·73)

Notes: Outcome of pregnancy was dropped due to collinearity. All steps were adjusted for current use of contraception, survey year, type of residence and religion. *Centred at 18 years.

Appendix 6: Online supplementary material of paper 7.1

This material supplements but does not replace the content of the peer-reviewed paper published in Journal of Adolescent Health.

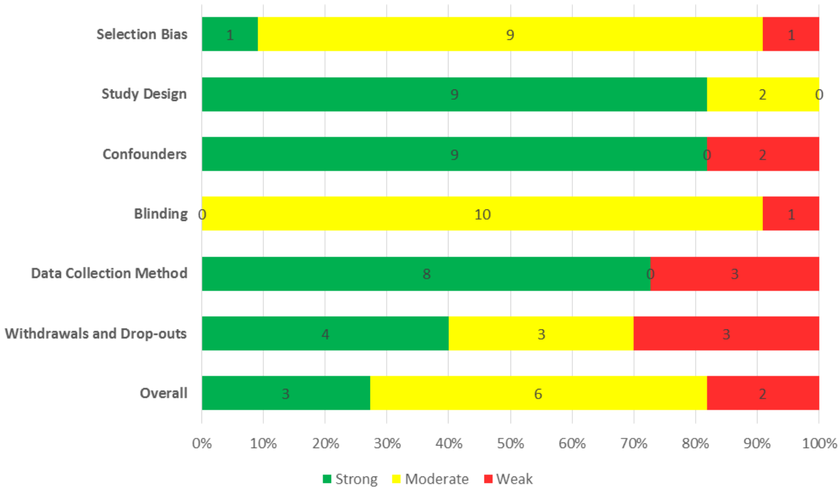


Figure S. 2. Quality assessment

Table S. 14. CHW towards repeated teenage pregnancies and births: Sensitivity analyses

Excluded study	Pooled ES			Heterogeneity		
	Pooled OR	LCI 95%	HCI 95%	Q	p-value	I^2
Repeated Pregnancy Outcome						
Barnet, et al. (2007)	0.92	0.68	1.26	13.14	0.04	54.34
Field, et al. (1982)	0.99	0.74	1.33	11.99	0.06	49.94
Havens, et al. (1997)	0.95	0.69	1.31	13.37	0.04	55.12
Kan, et al. (2012)	0.87	0.63	1.22	11.26	0.08	46.71
Kelsey, et al. (2001)	0.87	0.61	1.25	11.42	0.08	47.47
Polit and Kahn (1985)	0.97	0.68	1.38	11.47	0.07	47.70
Sims and Luster (2002)	0.96	0.70	1.32	13.23	0.04	54.64
Solomon and Liefield (1998)	1.05	0.86	1.27	6.60	0.36	9.14
Overall	**0.96**	**0.72**	**1.28**	**13.49**	**0.06**	**48.09**
Repeated Birth Outcome						
Barnet, et al. (2007)	0.70	0.48	1.01	16.30	0.01	69.32
Black, et al. (2006)	0.74	0.52	1.07	14.34	0.01	65.12
Kelsey, et al. (2001)	0.63	0.48	0.84	7.21	0.21	30.61
Ownbey, et al. (2011)	0.80	0.60	1.08	9.53	0.09	47.53
Polit and Kahn (1985)	0.68	0.43	1.07	15.85	0.01	68.46
Sangalang, et al. (2006)	0.65	0.40	1.07	16.37	0.01	69.45
Sims and Luster (2002)	0.68	0.46	1.01	16.37	0.01	69.45
Overall	**0.70**	**0.49**	**0.99**	**16.37**	**0.01**	**63.34**

**ES-Effect size; OR-Odds ratio; CI-Confidence interval*